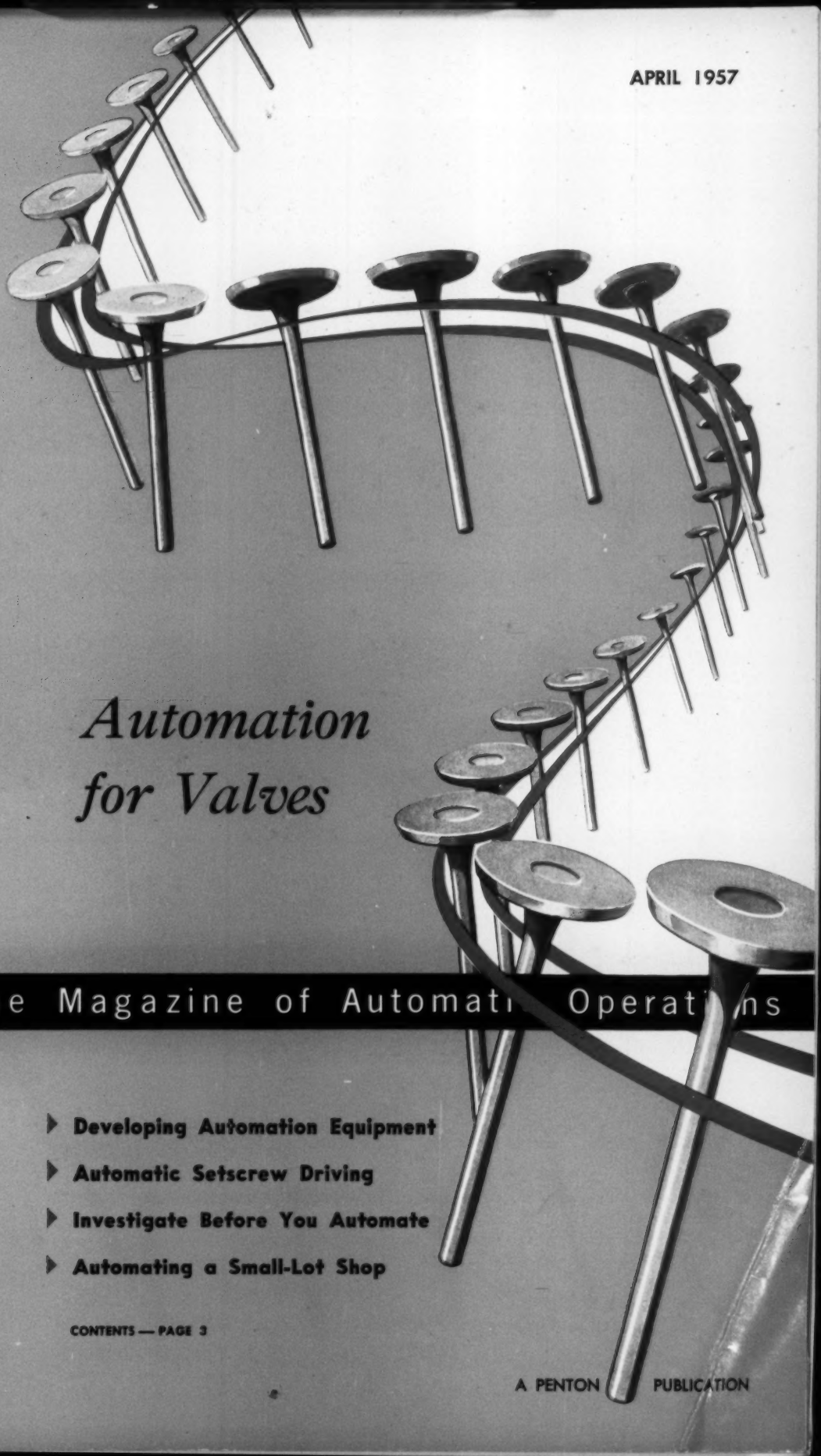
AUTOMATION

APRIL 1957



Automation for Valves

The Magazine of Automati Operati ns

- Developing Automation Equipment
- Automatic Setscrew Driving
- Investigate Before You Automate
- Automating a Small-Lot Shop

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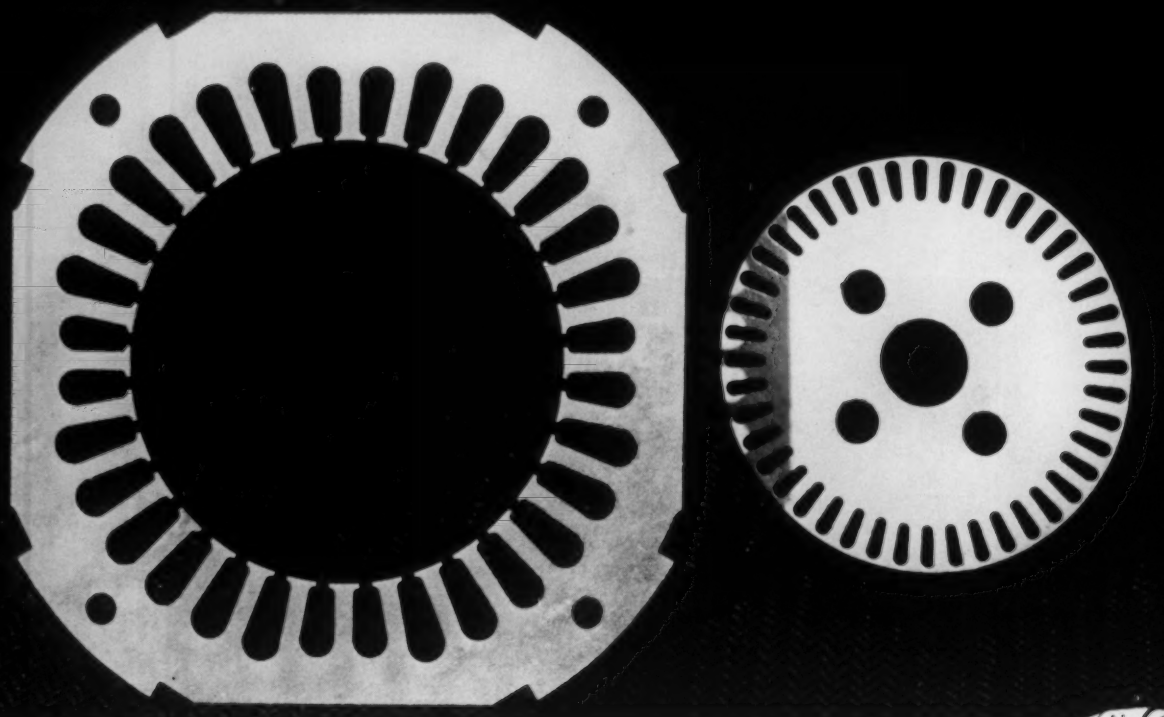
A PENTON PUBLICATION



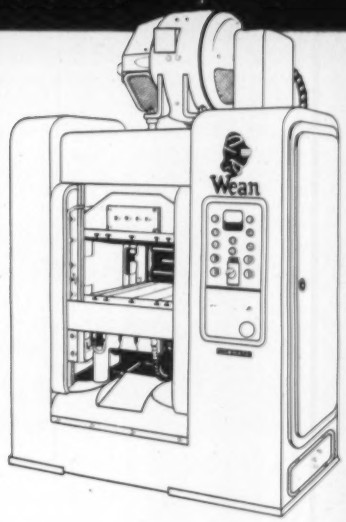
What shape is your production in?

Production Rate:

Conventional Press — 180 two-piece units per minute.
Wean "Flying Press" — 300 two-piece units per minute.

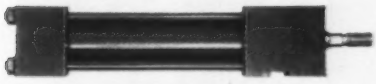
Both of these electric motor parts, measuring 3½" and 5½" in diameter respectively, were produced in a single set-up on a conventional press at the rate of 180 per minute. Using the same dies, the "Flying Press" produced these parts at the rate of 300 per minute. This is typical of the type of production rates that result when the job is done on a "Flying Press."

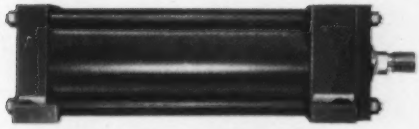
Although engineered for the ultra-high speeds, the "Flying Press" offers other major cost-saving advantages too. For instance, since it has no brake or clutch to wear out, maintenance savings alone are an important consideration. But you'll want the complete story so . . . write today for your copy of the "Flying Press" brochure. It will open your eyes to new production horizons.



Wean Equipment Corporation
CLEVELAND 17, OHIO

Circle 551 on Inquiry Card



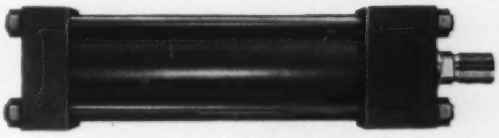


Five cylinder series... each the best of its kind!

Here you see one more reason why experienced cylinder users prefer Hannifin cylinders...there is a Hannifin cylinder series for every type of service.

What pictures cannot show you is the extra effort that goes into every Hannifin cylinder, all the way from the drawing board to the shipping dock. This brings you design features other cylinders simply do not have...superior workmanship where it's most needed for long, trouble-free service...and better delivery promises, better kept. All at prices no higher than you may have been paying for less satisfactory cylinders.

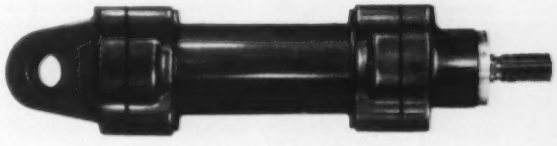
There's a Hannifin man near you—or, if the need is urgent, call us long distance. He or we will welcome the opportunity to help you as you select the Hannifin cylinder series that best meets your needs.



AIR AND HYDRAULIC

HANNIFIN

POWER CYLINDERS

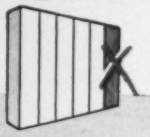


COMPLETE CYLINDER FILE

Write for your copy of this new Hannifin Cylinder File...complete, easy-to-use, easy-to-order-from information on five lines of Hannifin cylinders. Write Hannifin Corporation, 541 S. Wolf Road, Des Plaines, Illinois.

Circle 554 on Inquiry Card

NEW CLARK CONTROL CENTERS CAN SAVE YOU ONE VERTICAL SECTION FOR EVERY FIVE!



features:

- SPACE SAVING
- SIMPLER MAINTENANCE
- GREATER VERSATILITY
- MAXIMUM SAFETY
- STRONGER and MORE RIGID

plus!

- CLARK TYPE "CY" STARTERS, OF TIME PROVEN SUPERIORITY

WRITE for your copy of this informative book containing complete information for adapting the new CLARK space-saving CONTROL CENTERS to your needs.

and each section is only 20 inches wide!

You *save space* two ways with new CLARK Control Centers—vertical sections are only 20" wide, and each vertical section can house up to 6 size 1 or 2 non-reversing combination starters. Thus 30 starters can be accommodated in 5 sections—total width only 100 inches—compared with 6 sections of ordinary 5-unit design and considerably greater width. *Maintenance* is easier because all wiring and service—even bus replacement—is from the front or top. Parts are standardized for greatest *versatility* and *flexibility*—making it simpler to adapt units to particular needs or alter arrangements after installation. For *maximum safety*, all bus is completely enclosed and empty compartments are protected by insulating barriers and closure panels. Heavy gauge steel plus exclusive design providing support for all load bearing members without dependence on shear strength of screws, assures added *strength* and *rigidity*.

For complete information contact your nearest Clark sales office or Clark distributor, or write us direct.

The **CLARK CONTROLLER** *Company*

Everything Under Control

1146 East 152nd Street • • Cleveland 10, Ohio

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APRIL 1957
Vol. 4—No. 4

AUTOMATION®

A PENTON PUBLICATION

The Magazine of Automatic Operations

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automation outlook

SUCCESS EARMARKED

". . . engineers and managers know that behind every success in this field there was hard work and possibly disappointment. Not every venture has a happy ending. Many manufacturing companies, both large and small, have made significant progress in raising their level of automaticity. Out of this experience, basic principles which tend to earmark success can be singled out. . ."—*James J. Lahm, equipment development engineer, Westinghouse Electric Corp., see page 36.*

EDUCATION REQUIRED

". . . automation is one of the pressing problems facing today's designers of machine tools. The problem includes more than designing of the equipment; it requires an educational program for plant managers, customers, the working forces, and many others who have little or no part in the actual design of equipment. . ."—*Walter G. Johnson, manager of research and engineering, Grinding Machine Div., The Norton Co., see page 68.*

AUTOMATION FOR ALL

". . . automation will not be the exclusive domain of the big corporations. It will be adopted, whether by large or small business, if—when all the eventual costs are totaled up—it is actually cheaper and/or better than continuing present methods. Look at it this way: It is easier to 'automate' manufacture of a transmission or axle than it is to 'automate' production of a complete automobile. This suggests that the production of component parts by suppliers to numerous industries may lend itself to automation rapidly. . ."—*Malcolm P. Ferguson, president, Bendix Aviation Corp.*

DANGER FROM FAILURE

". . . fears have been expressed that automation may take place more quickly than people can be trained to fill new jobs. That this is an erroneous assumption is easily understood when we consider that equipment of this type can neither be designed nor built before there are sufficient trained people to do the job. Further, this equipment can be neither installed nor used until there are sufficient trained personnel to operate and service it. Obviously, automation can take place only as rapidly as the necessary upgrading of skills develop. Therefore, the danger in failing to have enough trained manpower is not unemployment but a slowing down of the technological progress. . ."—*Robert T. Sheen, president, Milton Roy Co., and president, Instrument Society of America.*

FAVORABLE OUTLOOK

". . . prospects for increased industrial use of electrical equipment are enhanced by the growing trend toward factory automation; that is, the use of machinery to move material in process to and from successive operations. The trend toward fewer workers per item produced and increased mechanization of manufacturing operations is not a new development; however, new technological developments, particularly in electronic control systems, has led to an acceleration of the trend . . . because of the growing trend to factory automation and the use of complex control systems for automatic machinery, the outlook for producers of light industrial equipment and control devices is favorable. . ."—*Investment Bulletin of American Institute for Economic Research.*

AUTOMATION

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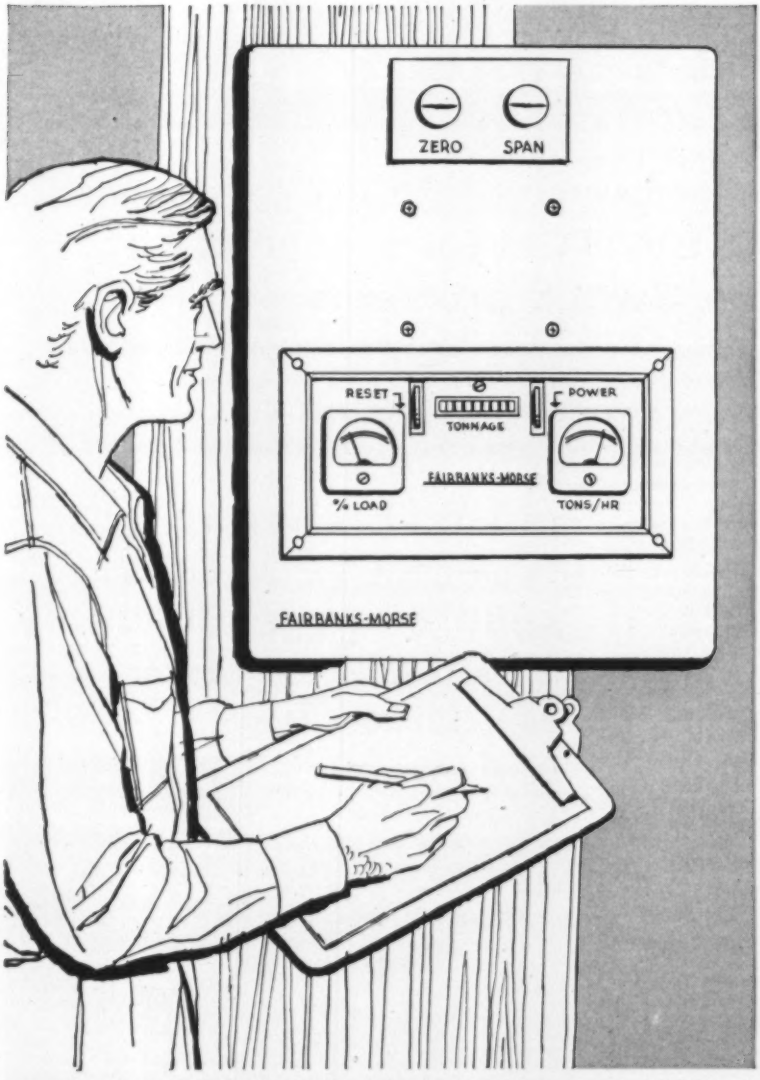
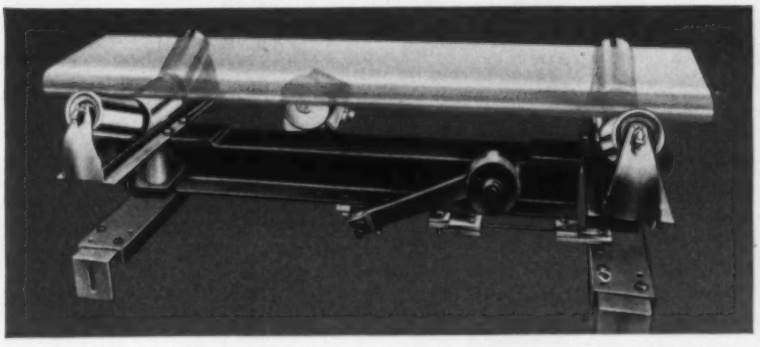


Weigh it on the run ...with electronics

There are no labor costs to be charged against weighing when you incorporate a Fairbanks-Morse electronic scale in your belt conveyor system. The belt will be moving anyway, and might as well be accumulating the record of passing weight in the process.

Because it is electronic, the registering instrument of the new Fairbanks-Morse Electronic Belt Conveyor Scale can be located remotely—for instance in the office with the rest of your business and accounting machinery.



Accumulated weights are read on the remote instrument in digital figures, and there are other indicators to give you a running check on the general efficiency of your conveyor operation. A meter shows percentage of load at the given moment; another shows the rate of tonnage movement per hour.

There's a new bulletin, No. ED-12, on the Fairbanks-Morse Electronic Belt Conveyor Scale. Please write for it today. Fairbanks, Morse & Co., Dept. A-4, 600 South Michigan Avenue, Chicago 5, Illinois.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

SCALES • PUMPS • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MOWERS • MAGNETOS

Circle 557 on Inquiry Card

MICRO SWITCH Precision

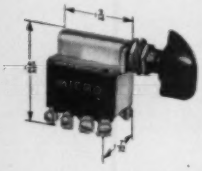
...FIRST IN PRECISION SWITCHING

If reliability, long life, ruggedness, compactness, sensitivity and accurate repeat point of operation are vital to you, then

Look to MICRO SWITCH for a solution of your Precision Switch problems

Here is a partial picture of some of the thousands of switch combinations available—news of a new MICRO SWITCH development—how and for what and why one manufacturer is using MICRO SWITCH Precision Switches—and a report on what MICRO SWITCH field application engineering can mean to alert design engineers

This MICRO SWITCH 3-Position Rotary Actuated Switch is compact and rugged



Ideal for airborne and industrial use, this switch is a four-pole double-throw switch with 12 terminals (catalog listing 4TR1). An eight-pole with 24 terminals is also available (catalog listing 8TR1) . . . Eliminates use of relays. Tested for impact, shock, acceleration and vibration. Careful inspection assures long life operation. Positively detented positions eliminate accidental operation. The solid silver contacts and silver-plated copper moving contact carrier provide maximum conductivity, minimum temperature rise.

(For more details ask for Data Sheet No. 112)

CHARACTERISTICS

Operating Torque (4TR1) . . 9 in. lbs. max.
Pretravel . . . . . 10° each direction
Operating Torque (8TR1) . . 4 in. lbs. min. to 6 in. lbs. max.

ELECTRICAL RATING 4TR1 & 8TR1

Continuous	Resistive Load		Lamp Load		Inductive Load	
	30 v dc	115 v ac	30 v dc	115 v ac	30 v dc	115 v ac
20	20	20	5	4	12	15

This Compact Limit Switch Is Widely Used by Industry

This is a double-pole two-circuit switch, completely sealed. Cover screws are held captive in cover when it is removed. The ½ n.p.t. internally tapped opening is in the bottom of the enclosure . . . Actuator can be positively locked in any position through 360° and can be operated in either direction. Actuator head is removable in field, can be rotated to any of four positions. This switch can be mounted either front or back side, .192-inch diameter holes extend through the enclosure, tapped from the back to a depth of 9/16-inch with ¼-20 nc thread. Mounting holes accept No. 10 screws. No. 8 terminal screws accommodate No. 14 stranded wire. Can be used single-pole double-throw.

(Ask for Catalog 101)

CHARACTERISTICS

Operating force—3 lbs. max. Pretravel—20° max.
Full overtravel force—6 lbs. max. Diff. travel—12° max.
Release force—½ lb. min. Overtravel—30° min.

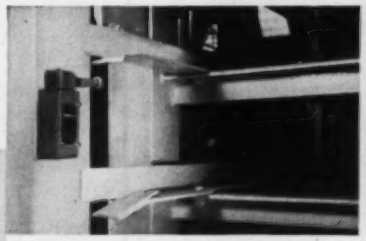
Rated: 10 amps. 120, 240, 480 v ac; ½ H.P. 120 v ac; 1 H.P. 240 v ac; .8 amp. 115 v dc; .4 amp. 230 v dc; 1 amp. 550 v dc. Pilot duty rating 600 v ac. max.

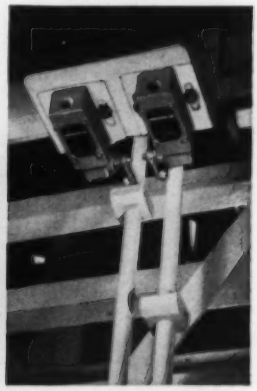
15 MICRO SWITCH Precision Limit Switches Assure ABSOLUTE DEPENDABILITY in Particle Board Loader and Unloader Unit*

Operates 20,000 cycles per day on a 24-hour basis

•

Prevents shut-down time at estimated cost of $50.00 to $100.00 per minute





Three of the many MICRO SWITCH Type "ML" 2-circuit switches index the cage stops of the upward and downward travel of the racks of the particle board loader and unloader unit.

Operating 20,000 cycles a day, these rugged MICRO SWITCH "ML" Limit Switches with their long life, accurate repeatability of point of operation, excellent seal, convenient mounting and one-way actuation features, provide dependability for the continuous high speed production of particle board.

Serving as indicators and timers in various automatic operations, these two-circuit switches control the up and down motion of the unit which loads and unloads the particle board to and from the hot plate press.

The manufacturer* of these custom-built units has standardized on MICRO SWITCH Precision Switches because of their longer life, accurate and dependable operation and excellent environmental seal. As many as 100 switches are used on some of these custom-built units.

(Ask for Catalog No. 83 "Industrial Enclosed Switches")

*Washington Iron Works, Seattle, Washington

Switches have uses unlimited

NEW!

A Subminiature Screwdriver Operated Switch— Saves Wiring and Panel Space

Designed to be used where there is limited access and where accidental operation must be prevented. Switch is operated by a 90° turn of a screwdriver and the slotted head gives visual indication of its position. The switch can be ordered with a number of variations of the subminiature basic switch. Contact arrangement is single-pole double-throw (maintained position).

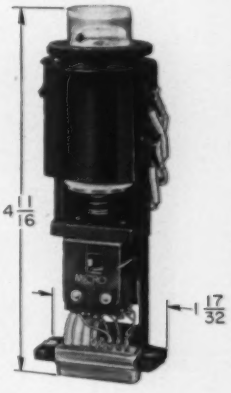
(To learn full details of this new switch, send for Data Sheet No. 115)

ELECTRICAL RATING

Listed by Underwriters' Laboratories at 5 amps. 125 or 250 v ac. The 30 v dc is: inductive—3 amps. at sea level, 2.5 amps. at 50,000 ft., resistive—4 amps. at both sea level and 50,000 ft. Maximum inrush capacity—20 amps. ac and 24 amps. at 30 v dc.

MICRO SWITCH 3-Light Pushbutton Switch Reduces Panel Space 50%

This compact, double-throw double-pole switch with its prewired plug will light in three different colors. It was developed expressly for use in complex console panels. Because push button and switch are combined in one unit, it reduces panel space by 50%. The compact stem carries three separate lamps. The switch incorporates a special connector plug which permits quick and easy installation and replacement—no complicated wiring required. Designed for use where high reliability is a requirement; two SPDT precision subminiature basic switches with fine silver or gold contacts and special treated snap-acting springs are the switching elements. All materials are corrosion resistant.

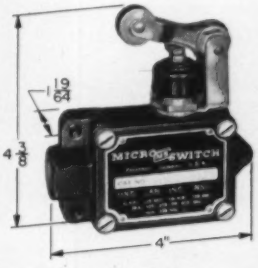


(Data Sheet No. 110 will give you more details. Send for it!)

ELECTRICAL RATINGS

Rated for .1 amp. inductive at 28 or 48 v dc and 1 amp. inductive at 115 v ac.

For Tough Service in Industrial Applications— The "BAF1" High Capacity Series



Especially designed for rough, general service in industrial applications, these MICRO SWITCH Precision Switches are protected from the effects of dirt, dust and occasional liquid splash by an elastomer boot on the plunger and an O-ring gasket under the cover plate . . . This series is really rugged, the three mounting holes in the heavy mounting flange accommodate ¼ in. bolts. These switches have a capacity to make and break steady state currents of 20 amperes and will handle inrush currents as high as 75 amperes. If your service requirements are rugged, this rugged switch will handle them.

(You can learn all about this series, if you send for Catalog No. 83)

CHARACTERISTICS

Operating force	2 lbs.
Release force	1/2 lb. min.
Pretravel	7/32 in. max.
Overtravel	1/4 in. min.
Differential Travel	.015 in. max.

Service Pays Off Again; for Orin McIntyre

"We don't sell switches, we *give* service. Give them the right switch for the job and the switches sell themselves."

That's the sales approach of Orin Mac McIntyre, MICRO SWITCH salesman. And Mac's approach recently paid off.

Mac offered his talents to a prospective customer's engineers, hoping to assist them with their switching problems.

Mac kept at it and finally found the "in." The prospect needed heavy-duty limit switches with extremely light operating force and soft-roller actuators to prevent breakage of his product. Mac checked the home office, found the perfect solution, and had two samples in the hands of the prospect—pronto.

This prospect's engineers found these switches ideal for their needs, and issued an order.

This fast and efficient service made an impression. Soon Mac was called in on another switching problem which resulted in a second order.

Through Mac's efforts, MICRO SWITCH has gained the added respect of this company.

MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

In Canada, Leaside, Toronto 17, Ontario • **FREEPORT, ILLINOIS**

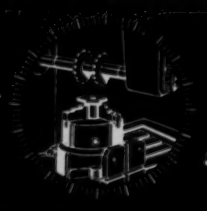
NEW

ERICKSON

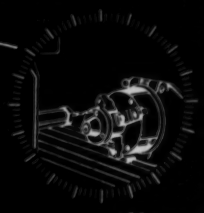
MASTER SPACER

with No. 0 Timken Bearings

gives increased production and optimum accuracy in



straddle milling



milling

jig drilling
with either micrometer or "Jo" block setting

inspection

The new Erickson Master Spacer quickly and accurately positions work for a wide variety of jobs. This *one* tool can eliminate expensive jigs and fixtures . . . makes it a simple procedure to set up drilling, milling, boring and special machining operations.

The new Erickson Master Spacer, ideal for tool room and production machining, assures outstanding performance under heavy helical cuts and slow feeds. *Indexing accuracy guaranteed within .001-inch cumulative error on a 6-inch diameter circle.* Jig drilling is possible with either micrometer or "Jo" block setting. Timken bearing construction permits work to be trued in position with brake off because spindle alignment remains unchanged.

The new Erickson Master Spacer can help you come to grips with your Number One Problem—high production costs. The first step is to get the Erickson story.

AA-3091

Write for free catalog "Erickson Master Spacer" today. And at the same time request your copy of Catalog K; you'll find cost-slashing applications for all Erickson holding tools.

ERICKSON TOOL COMPANY

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AUTOMATION news

Today's events and developments in the field of automation

Joint Consultation Pays Off

EXPERIENCE of various New York State companies and unions shows that impact of automation can be cushioned. Reports indicate that joint consultation has saved management from padded payrolls and makework, has protected workers from unemployment, and has benefited communities by averting costly labor strife. As reported in the *Industrial Relations News*, the following pattern for dealing with automation has emerged in recent years in New York State: Need for exchange of information develops out of the early confusion surrounding the introduction of automation; by mutual consent, parties agree to talk out problems arising out of the installation of new machinery; and settlements of specific problems are thrashed out and the stage is set for working out contract provisions.

Formal contract provisions for dealing with automation and related problems have also been established. Provisions have been made for committees on automation and for joint consultation on associated problems; arbitration of disputes arising from introduction of automation; upgrading and higher rates for automated jobs; and training and retraining workers within plant at company expense.

It has been found that revision of seniority and transfer provisions, including preferential hiring, to give displaced workers better chances to get other jobs, is beneficial. It has also been determined that workers have been eager to get on automated jobs. They find the work is less exhausting, more stimulating, and union stewards report that fewer grievances arise in automated departments.

AUTOMATIC molded unit test set developed by Air Arm Div., Westinghouse Electric Corp. checks packaged oscillators, amplifiers, modulators, etc. while these circuits are energized. The subassemblies can be checked at a rate exceeding handling operations. Programing of the test is accomplished with a patch board which programs the input parameters and output comparison circuits. A test time reduction of 95 per cent has resulted from the use of this machine.

Remote Control Adjustment Of Automatic Press Unloaders

DESIGNED for use with existing and new Sahlin Iron Hand installations, a new remote control system for adjusting automatic press unloaders has been developed by Sahlin Engineering Co. Inc.

With the new unit, operators can adjust unloaders by merely turning calibrated dials instead of using the slower, manual and less precise methods of adjusting pneumatic time delay needle valves, speed control and sequence valves, and shut-off valves. Nine different adjustments are possible including main cylinder speed control, delay between jaw gripping panel and lifting action, jaw release point, arm stroke and overtravel, arm return stroke delay, independent arm or jaw operation, and press unloader cycling independent of the press. Time delay increments from zero to 6 seconds are provided.

The contact control panel can be mounted on the press column or any other convenient location. A cable connects the unit to the press unloader. Installation on an existing unit of the conventional type requires no change in the press or press circuits.

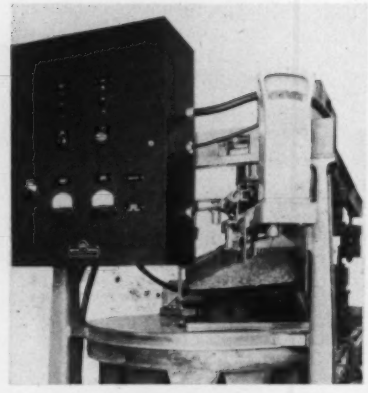
Ford Expansion Continues

CONTINUING the facility expansion begun 10 years ago, the Ford Motor Co. has announced that about $710 million has been earmarked for 1957 expenditure—the second highest outlay for any year, being topped only by the approxi-

mate $780 million spent in 1956 for facilities growth and tooling. In reporting the planned outlay for accelerated plant expansion and tooling programs, Ernest R. Breech, chairman of the board, said, "Our expansion program not only will give us the production capacity required for broadening of our line of products, but sales of our products since the introduction of the 1957 models indicate that greater capacity will be needed to meet the growing public preference for all of our car and truck lines." All told, 39 new manufacturing and assembly plants, 21 parts depots, two huge proving grounds, and 19 engineering, research and office buildings and other facilities are included in Ford Motor Co.'s postwar expansion program.

Communication System Uses Modulated Light Beam

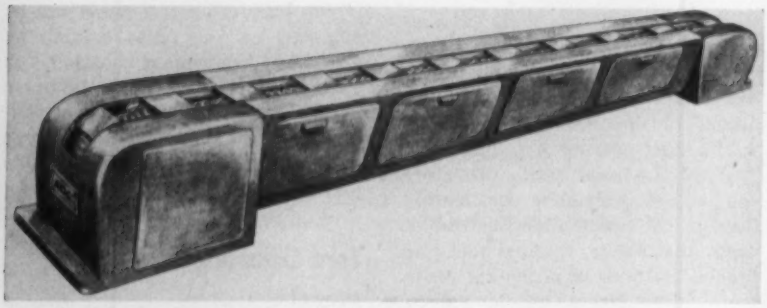
BASED on a technique developed by Baird-Atomic Inc., a new system of communication by light beam has been demonstrated. In the demonstration a local television program was picked up on a conventional receiver. The video signals from this receiver were also fed to an electro-optical system which was directed at a remotely positioned photomultiplier tube. The signal picked up by this detector was then led into the video section of a second commercial TV receiver. The light beam transferred all signals as effectively as the conventional system.



VIBRATORY feed mechanism, electronically controlled to assure filling accuracy, permits filling speeds in excess of 350 cartons per minute. As the product to be packaged moves down the vibrator trough to the filling head, it is automatically weighed. If product density or rate of flow varies from a preset condition, the controls automatically adjust the intensity of vibration of the trough to restore the rate of flow to the desired level. This form of feeder control is located on a new Stokes & Smith Co. packaging machine which is designed to handle free-flowing products such as cereals, spices and chemicals in small size cartons. No inner-liner is required in achieving a sift-proof, air-tight seal in packaging free-flowing products.

Dr. Walter Driscoll, vice president in charge of research for Baird-Atomic Inc., stated that the system holds certain advantages over existing microwave television, telephone or radio links. Light waves, shorter in wavelength than radio waves, are transferred by optical lens or mirrors. Such components are considerably smaller than radio antenna components, and thus more portable. Also, because of the small point source, a mirror can direct a narrow light beam over a distance of several miles with no detectable or wasted light energy outside the beam. If either transmitting or receiving portions of the optical link are not fixed points but are on mobile mounts, wider angle beams can be provided using broad light sources and/or multiple receiving or transmitting optics. With this type of system, numerous light beam communications systems can be initiated. Single or multiple channels of voice communications or a complete television channel can be propagated over a considerable distance under appropriate conditions —appropriate conditions being defined as moderately good weather.

The system consists of a constant source of light, modulated by projecting a constant intensity beam through an electro-optic shutter. This latter device, a doughnut shaped unit 2 inches in diameter and 1 to 2 inches thick, is an optical component with no moving mechanical parts. The shutter's synthetic crystal plate, placed in the path of a light beam, causes the light to be modulated.



NEW in-line transfer machine has been developed by Automation Development Corp., Mentor, O. Designed for assembly and machining operations which might include manual stations as well as stations with automatic tooling, the basic unit consists of a center and two end sections. The center section may be lengthened as additional operations are required. Indexing is by means of a reciprocating drive based upon an air cylinder; the index stroke is adjustable up to 12 inches. Air and electrical manifolds run the full length of the machine with provisions for outlets wherever required.

A Parable for Moderns

A WHOLESALE bakery, with fewer than 1000 employees, recently set an example which farsighted business management would do well to follow.

To meet growing demands of retail chains, this bakery decided to erect a new, fully-automated plant. For some processes, output per man hour was to be 40 times higher than before. With automation, to hear some wild tales, one would have expected to see many men thrown from their jobs. Another item in the picture: The plant was unionized—one would have expected the union to resist new machines.

What, in fact, took place was a lesson in the practical meaning of "management-employee communications."

As soon as the decision to build was made—made solely by management — the union's business agent was informed (neither asked, nor ignored, but informed). He

Lubrication is automatic on Sundstrand's "Engineered Production" machine tools

FARVAL—
Studies in Centralized Lubrication
No. 182

The idea behind Sundstrand "Engineered Production" Service makes sense: Manufacturer and Sundstrand Engineers work closely together to find the best processing method for the job at hand. The result is the same as you experience with a custom-tailored suit—it fits.

FARVAL fits Sundstrand pattern

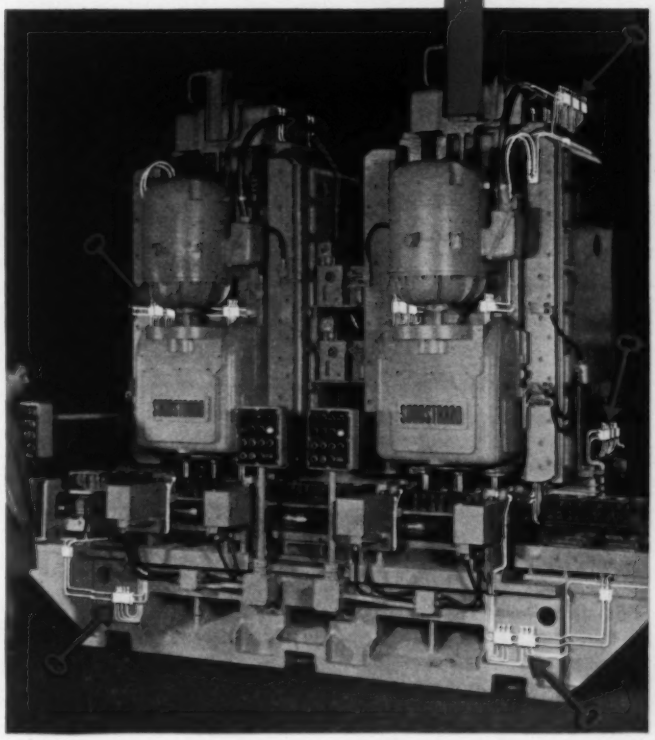
Farval Centralized Systems of Lubrication, like Sundstrand Machine Tools, are engineered for the job. Where there are bearings to be lubricated, Farval will make sure the job is done correctly. That's why Sundstrand chooses Farval—and why other machine-tool specialists are doing likewise.

It works like this: As *the* Dualine system of centralized lubrication, Farval delivers a measured amount of clean lubricant at regular intervals to *every* bearing in the Farval circuit. From a centrally located pump and reservoir, lubricant is pumped under pressure, to a measuring valve at each bearing. The exact amount of lubricant required by the bearing is delivered to it. And, indicators at every bearing show *positive proof* that each valve has functioned.

Let Farval help you

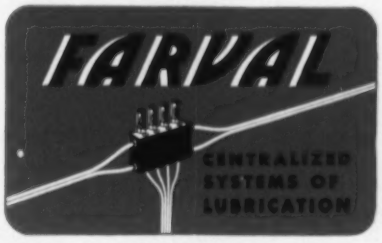
Lubrication problems that seem tough for you are a cinch for Farval. One of our lubrication engineers will be glad to inspect your plant and present a written analysis of what Farval can do for you. This service is without obligation, of course. If you'd like the complete Farval story, just write for Bulletin 26-R. The Farval Corporation, 3265 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Co., Industrial Worm Gearing. In Canada: Peacock Brothers Limited.



This is a Sundstrand two station rough boring unit for 6 cylinder engine blocks.

KEYS TO ADEQUATE LUBRICATION— Wherever you see these Farval valve manifolds, dual lubricant lines and central pumping station, you know a machine is being properly lubricated.



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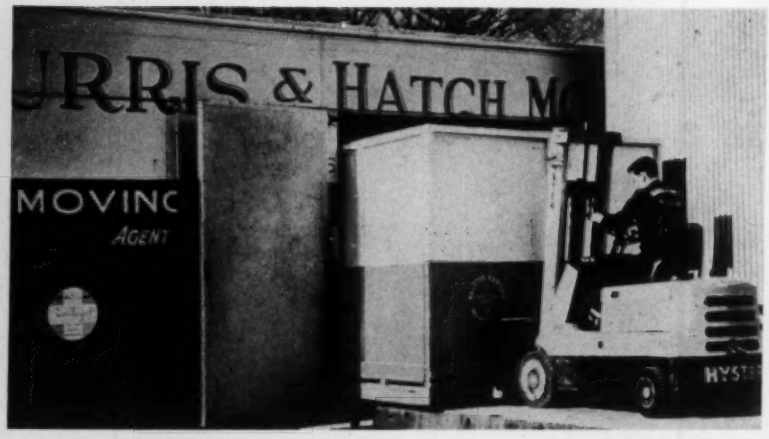


NEW SYSTEM for handling and storage has been developed by Burris & Hatch Movers of Des Moines, Iowa. Method involves the loading of household effects into specially designed plywood boxes containing approximately 364 cubic feet of space. Two such units can normally accommodate five rooms of furnishings. Once the boxes are loaded with furnishings, they can be removed from their specially designed vans by mechanized handling equipment for placement in storage or transfer to other vans. According to officials of the Hyster Co., who have helped pioneer many such methods, the use of large containers and mechanized handling equipment is growing rapidly in all industries.

was further informed that the company expected 25 per cent fewer production workers in the new plant.

For five years, until the new plant was in full operation, management and union officials conferred frequently. The management group entertained suggestions for job changes from the union, but retained full authority for decisions in all areas. Here are some of the results:

No work stoppages have occurred.

Wage boosts have been made, but unit labor costs reduced.

Wastage is down, output and sales up.

Customers are happier too, since a fresher product is being delivered.

And the final chapter to this story is that with the new automated plant finally in full operation, employment actually exceeds the former level.—from *Economic Intelligence*, Chamber of Commerce of the United States, Dec. 1956.

Smaller Firms Show Interest In Data Processing Equipment

MARKETING progress report issued by IBM on the RAMAC data processing machines emphasizes the interest of business in flexible electronic data processing equipment. Within 5 months after the equipment was first announced, more than 1000 RAMAC systems were ordered from IBM. In analyzing the orders, an interesting fact has been noted. The majority of the orders are not from the larger corporations that have been associated with electronic data processing but rather from medium sized companies of all types. Represented are the wholesale grocery field, hardware business, meat packing industry, airlines, department stores, and food chain stores.

Improved Magnetic Alloy Permits Smaller Magnets

SUBSTANTIAL improvements in power transformers, magnetic amplifiers, switching and memory devices, and pulse transformers are now possible with the use of a new magnetic alloy which has been developed at Bell Telephone Laboratories. The new magnetic material will permit reductions in the size of magnetic components without any sacrifice in performance. Called Supermendur, the alloy has a number of exceptional properties, including higher permeability and lower hysteresis losses at higher flux densities than material heretofore available. Hysteresis losses have been reduced by a factor of 10.

The magnetic properties have

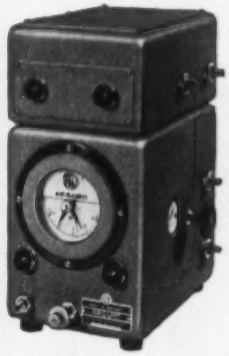
(Advertisement)

BUILD A GAGE INSTALLATION TO SUIT YOUR NEEDS . . .

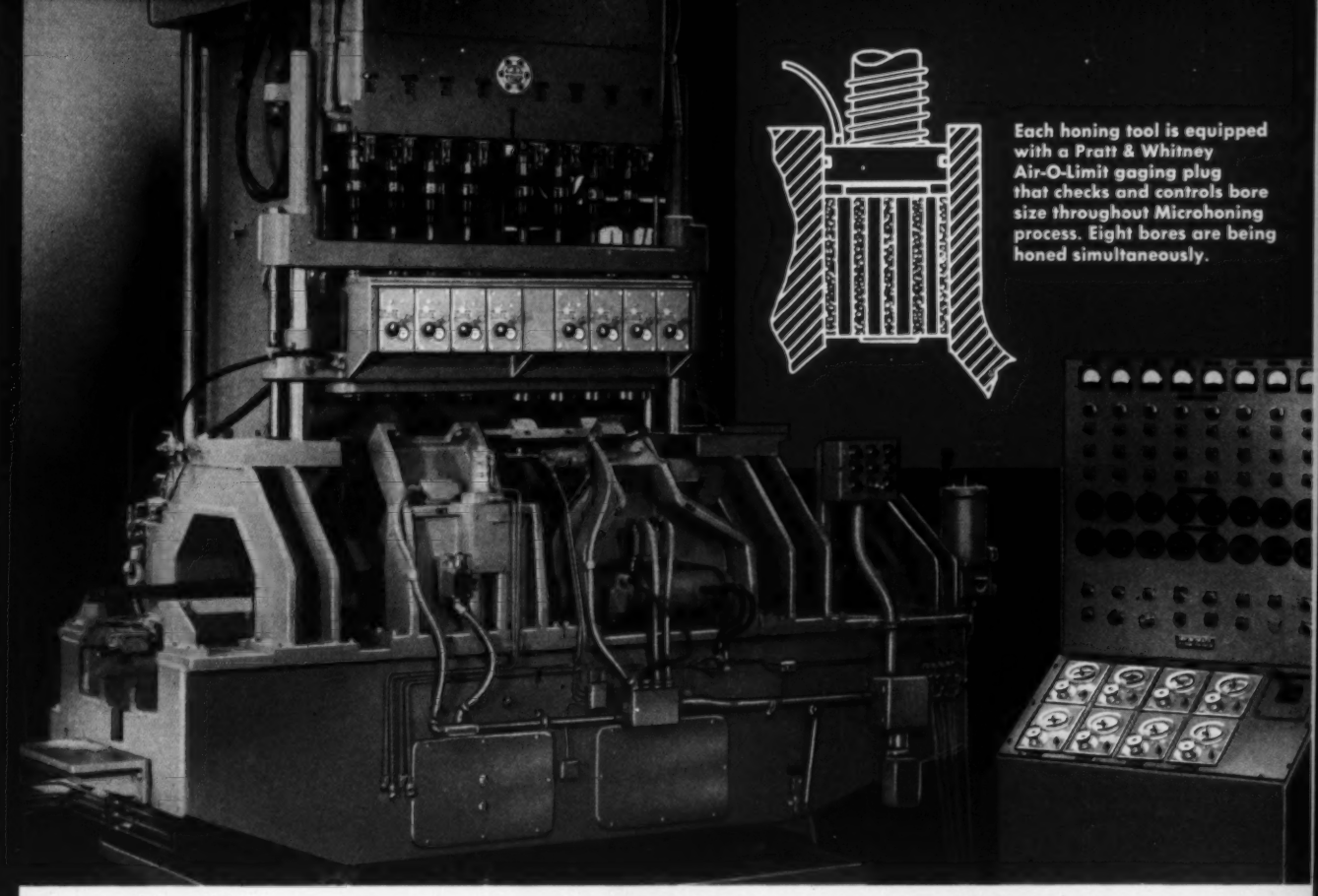
with these packaged, on-the-shelf P&W Air-O-Limit Light Signal Units. Can be used to signal operator or to provide feed-back impulse for fully automatic process control.

BASIC 2-LIMIT UNIT . . . indicates high and low tolerances. Suitable for sorting and other "yes-or-no" control applications.

3-LIMIT UNIT . . . especially suited for grinding and similar operations. Indicates or automatically controls such conditions as: "Fast Feed," "Slow Feed," and "Spark-Out."



4-LIMIT UNIT . . . similar to 3-Limit Unit, but provides greater control scope. Indicates or controls such conditions as: "Approach High Limit," "High Limit," "Approach Low Limit" and "Low Limit."



Each honing tool is equipped with a Pratt & Whitney Air-O-Limit gaging plug that checks and controls bore size throughout Microhoning process. Eight bores are being honed simultaneously.

PHOTO COURTESY OF MICROMATIC HONE CORPORATION, DETROIT, MICH.

Make Your Investment in Precision Pay Off in PRODUCTION

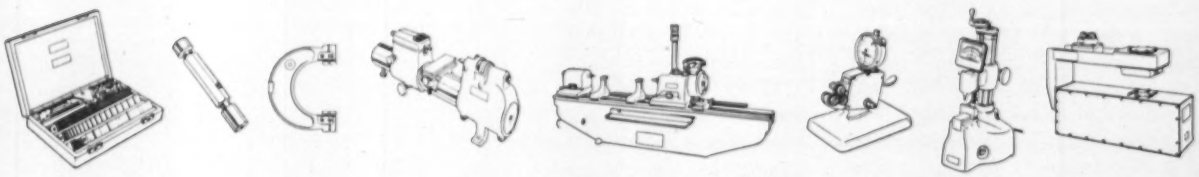
• • • WITH PRATT & WHITNEY "PACKAGED" AUTOMATION GAGE UNITS

Applied to your precision production machines, "P&W Automation Gaging" will make it possible for you to increase production, reduce scrap losses and put to work more effectively the high precision built into your equipment. And in addition, the use of Pratt & Whitney standard, on-the-shelf Packaged Gage Units will provide an installation *custom-tailored* to your exact needs *WITHOUT* the expense and delays involved in engineering and constructing special controls.

In this example – a Micromatic Hydrohoner – automotive cylinder blocks are gaged *during* the Microhoning process. When final size is reached, the machine is automatically shut off and the Microhoning tools are retracted. A change to a different bore size can be made, without stopping the machine, by a simple adjustment on a calibrated gage control dial. Visual indication is given of the accuracy of the new adjustment. Cylinder blocks are produced at a rate of 120 per hour. Reject and scrap losses are virtually eliminated.

Make the most of *your* investment . . . make it a point to call in a P&W Field Engineer to analyze your production requirements and recommend the right P&W Automation Gaging installation to help you increase output, improve accuracy and reduce reject losses.

Pratt & Whitney Company, Incorporated,
35 Charter Oak Boulevard, West Hartford, Connecticut.



GAGE BLOCKS . . . CONVENTIONAL GAGES . . . SUPERMICROMETERS . . . STANDARD MEASURING MACHINES . . . COMPARATORS . . . AUTOMATION AND CONTINUOUS GAGES

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been achieved by using commercial materials of the highest purity, melting in a controlled atmosphere furnace, and subjecting the resulting alloy to a prescribed schedule of rolling and heat treatment in a magnetic field. The material is so malleable that it can be cold rolled from 0.090-inch to 0.0003-inch without intermediate anneals and without losing its ductility.

Power transformer cores of 0.004-inch or 0.002-inch Supermendur tape can provide an output more than 30 per cent greater than comparable grain oriented silicon steel cores. Characteristics of the material make it ideally suited for power transformers, and magnetic amplifiers. Other possible applications include telephone receiver diaphragms, and switching and memory devices. Western Electric Co. does not plan to produce the alloy for commercial consumption. However, a number of companies have expressed an interest in the material and it will probably be manufactured under Western Electric license.

MERGER of the Cleveland Automatic Machine Co. with the J. H. Day Co. Inc. of Cincinnati has been announced. The operations of the latter will be continued as a division of the Cleveland Automatic Machine Co. The merger of the two companies is part of the expansion and diversification program of the R. K. LeBlond Machine Tool Co. which owns the Cleveland Automatic Machine Co.

When Instrumentation Is Needed Follow These Experts' Advice

FROM ANY NUMBER of viewpoints, the impact of automation on our society can be seen. Within recent times, several leading Wall Street houses have issued special reports on investment opportunities in the process control instrument field, more than 20 colleges and universities have established special engineering curricula related to automation, managers of business plants both large and small are reappraising their production control and research problems, and most recently, a full-dress investigation of instrumentation in the field of automation was held by the Joint Economic Committee of Congress.

This type of activity raises a big question in the minds of businessmen anxious to benefit from the instrument industry's contribution to better quality products, fewer rejects and less waste of men and machinery—how do you buy instruments for automation?

For the answer to that question, let's turn to some of the pioneers in the field, members of the Scientific Apparatus Makers Association, Recorder-Controller section. One thing should be noted—they are the first to admit that the increasing use of instrumentation as a part of modern process control is not revolutionary. From the first automated Philadelphia flour mill in 1784 until now, the introduction of process control instrumentation has charted a slow evolutionary growth.

EXTENT of automation in power generating stations is exemplified by a Republic Flow Meters Co. installation for Commonwealth Edison Co.'s Ridgeland generating station in Chicago. From the time coal is fed to the boilers until electricity moves into the transmission lines, every detail is guided and recorded in the pictured room. The station is equipped with four generating units with an aggregate capacity of 640,000 kw.

Henry F. Dever, president, Brown Instruments Div., Minneapolis-Honeywell Regulator Co., and one of the industry's leaders and spokesmen for automation, suggests, "Let's forget all about the technicalities and agree that automation is simply the process by which, through the use of machines, instruments and automatic controls, we make our industrial and business operations more automatic."

Dever continues, "like any modern businessman, you've recognized the fact that this concept of automation must be a part of your knowledge and understanding. You're anxious to acquaint yourself further with the broad aspects of today's technology and you're ready and anxious to discuss your manufacturing problems with 'people in the know.'"

Raymond E. Olson, president, Taylor Instrument Cos., Rochester, N. Y., keynotes the basic criteria of all investors in automation. He says, "Management, in considering automation through instrumentation should look first for dependability, second, flexibility and third, but not least, make sure that the organization he is dealing with is a reputable one."

B. H. Bristol, president, The Foxboro Co., Foxboro, Mass., advises, "Let's approach your investment in automation as a long time job, not to be permanently solved overnight with any available equipment." He suggests further that goals of what you want accomplished should be carefully worked out based upon the best available information on selected equipment.

Realize that it will take time to

XLO

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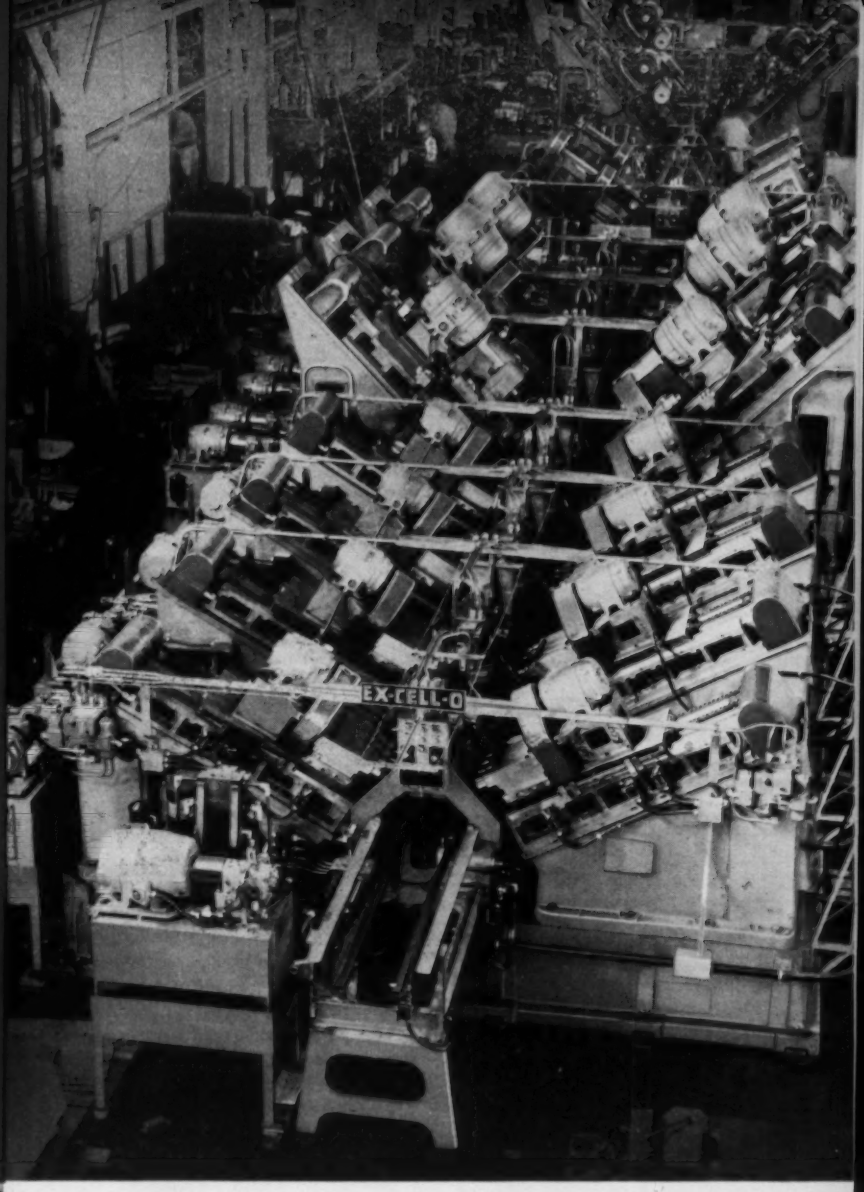
3000 Engine Blocks Per Day -

How one company competes in the world's toughest market . . .



The photograph above is a view in the auto plant shortly after the automation line was installed. At right above, a portion of the line as it neared completion in the Ex-Cell-O plant.

These Ex-Cell-O automation machines play an important part in turning out engine blocks for one of the "big three" of the automotive industry. This manufacturer's engine must compete in one of the toughest markets in the world.

Ex-Cell-O's part in the manufacturing process is 1200 feet of production line using the newest machines in assembled integrated units. Among the precision machining operations performed are boring, broaching, chamfering, milling, reaming and grooving.

Ex-Cell-O—builders of standard and special machine tools for 25 years—uses standard bases and subassemblies wherever possible. This means that product changes do not necessarily obsolete equipment. You save, too, in initial cost.

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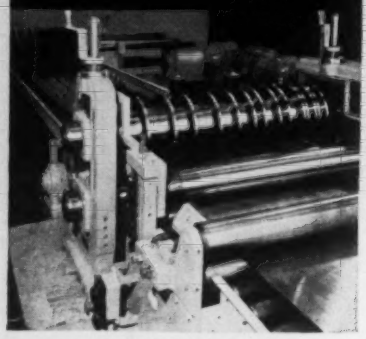
56-43

YODER SLITTING LINES



PAY BIG DIVIDENDS WORKING ONLY ONE DAY PER WEEK!

In one plant, two Yoder tube mills and about 50 punch presses are being supplied with slit strands by one Yoder Slitting Line operated an average of only *seven hours per week.*

In another plant, a Yoder slitting line, *operated from six to eight hours per week,* is supplying two intermittently operated roll forming machines with total requirements averaging 100,000 feet per week.

These typical examples demonstrate, first, the big potential output of a relatively small, inexpensive Yoder standardized Slitting Line and, secondly, its big profitability. Assume production of only 35 tons of slit strands per 8 hour shift, one day per week, and the total per year would be 1750 tons. Estimating the saving in slitting cost at only one-half cent per lb., the total annual saving would be $17,500.00.

Besides the big convenience of doing your own slitting, such savings will often repay the investment in a few months.

The Yoder Slitter Book **is a comprehensive treatise on slitter operation and economics, with time studies, cost analyses and other useful data. It is yours for the asking.**

THE YODER COMPANY
5528 Walworth Avenue • Cleveland 2, Ohio, U.S.A.

ENGINEERING YODER MANUFACTURING **SLITTING LINES**

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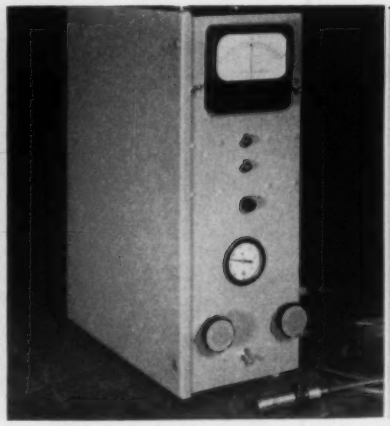

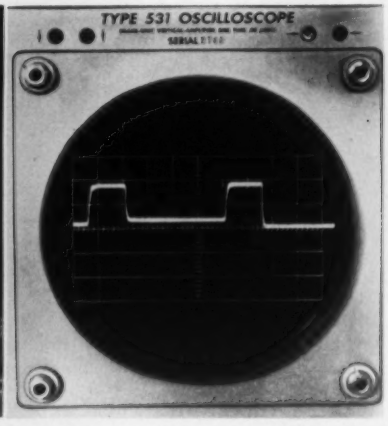

AIR-TO-ELECTRIC transducer developed by the Sheffield Corp. permits automatic gaging at cyclic rates fast enough to be used on in-process gaging installations. Cycles of more than 240 gaging operations per minute have been attained. The signal can be continually monitored by a device which actuates machine controls. A complete gaging operation, including size sensing, amplification, and signal to a production machine can be accomplished in from 30 to 40 milliseconds.

know how to take advantage of the more complicated equipment on the market and to train your organization. Ben Bristol continues, "experience will show how to make the greatest use of such equipment and what equipment to add. Too much equipment to start with may confuse the issue."

This instrument maker also cautions that you analyze the design of your plant. Make sure physical facilities can take advantage of the equipment you select. Check the economics of the equipment you decide to buy to avoid useless expense.

I. Melville Stein, president, Leeds & Northrup Co., notes that, "Decisions to adopt automatic control, or to add to it, can of course require amounts of study ranging from a few minutes' reflection to lengthy investigations and appraisals by teams of specialists. But, shunning both extremes, the following check points would seem to suggest the broader important considerations: (1) Is the process actually susceptible of automatic control, in full or in part, for present production? (2) Will the same automatic equipment be usable for future products? (3) How much will the equipment cost? (4) Will automation result in lower costs, improved quality, shortened deliveries or all of these? (5) Will automation require some fundamental change in the process, such as turning from batch to continuous processing? Will the plant have to operate around the clock or around the calendar?"

Harry E. Beane, vice president, The Bristol Co., Waterbury, Conn., offers more "food for thought" to those who are approaching automation for the first time. Beane emphasizes that, "There are a number of pitfalls and hazards to be avoided. Avoid 'fly-by-night' experts, people who claim to offer miracles without good sufficient proof of past performance. Miracles are sometimes possible, but the probability of the vendor producing one should be studied in advance by checking with recognized authorities, or on previous accomplishments.

"Pick the supplier who offers the most complete facilities, one who can do the whole job, (or the largest part of it) without going into untried fields and methods. Experimentation will sometimes be necessary, but it usually is more costly, and may result in a poor job."

Beane, concludes on another highly worthwhile note of advice for the business man; "Pick an organization with experience in a broad segment of industry. Very frequently, a problem in one industry will yield to a solution developed for a totally unrelated product or suggest such a solution. The connection between your problem and the other may not be apparent to you, but there are only a limited number of basic operations in industry, no matter how

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401	431	461	491	521	551	581	611	641
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403	433	463	493	523	553	583	613	643
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406	436	466	496	526	556	586	616	646
407	437	467	497	527	557	587	617	647
408	438	468	498	528	558	588	618	648
409	439	469	499	529	559	589	619	649
410	440	470	500	530	560	590	620	650
411	441	471	501	531	561	591	621	651
412	442	472	502	532	562	592	622	652
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415	445	475	505	535	565	595	625	655
416	446	476	506	536	566	596	626	656
417	447	477	507	537	567	597	627	657
418	448	478	508	538	568	598	628	658
419	449	479	509	539	569	599	629	659
420	450	480	510	540	570	600	630	660
421	451	481	511	541	571	601	631	661
422	452	482	512	542	572	602	632	662
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424	454	484	514	544	574	604	634	664
425	455	485	515	545	575	605	635	665
426	456	486	516	546	576	606	636	666
427	457	487	517	547	577	607	637	667
428	458	488	518	548	578	608	638	668
429	459	489	519	549	579	609	639	669
430	460	490	520	550	580	610	640	670

AUTOMATION **APRIL 1957**

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For additional free information circle item number on an inquiry card. Fill in your name, title, address, etc.—Drop it in the mail—No Postage Required—Your request will receive prompt attention and will be filled directly by the manufacturer.

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Keep Up-to-Date!

much they appear to differ from each other.

"The solution for your candy making problem may be exactly the same as one for a pulp and paper plant or an oil refinery which has already been successfully applied."

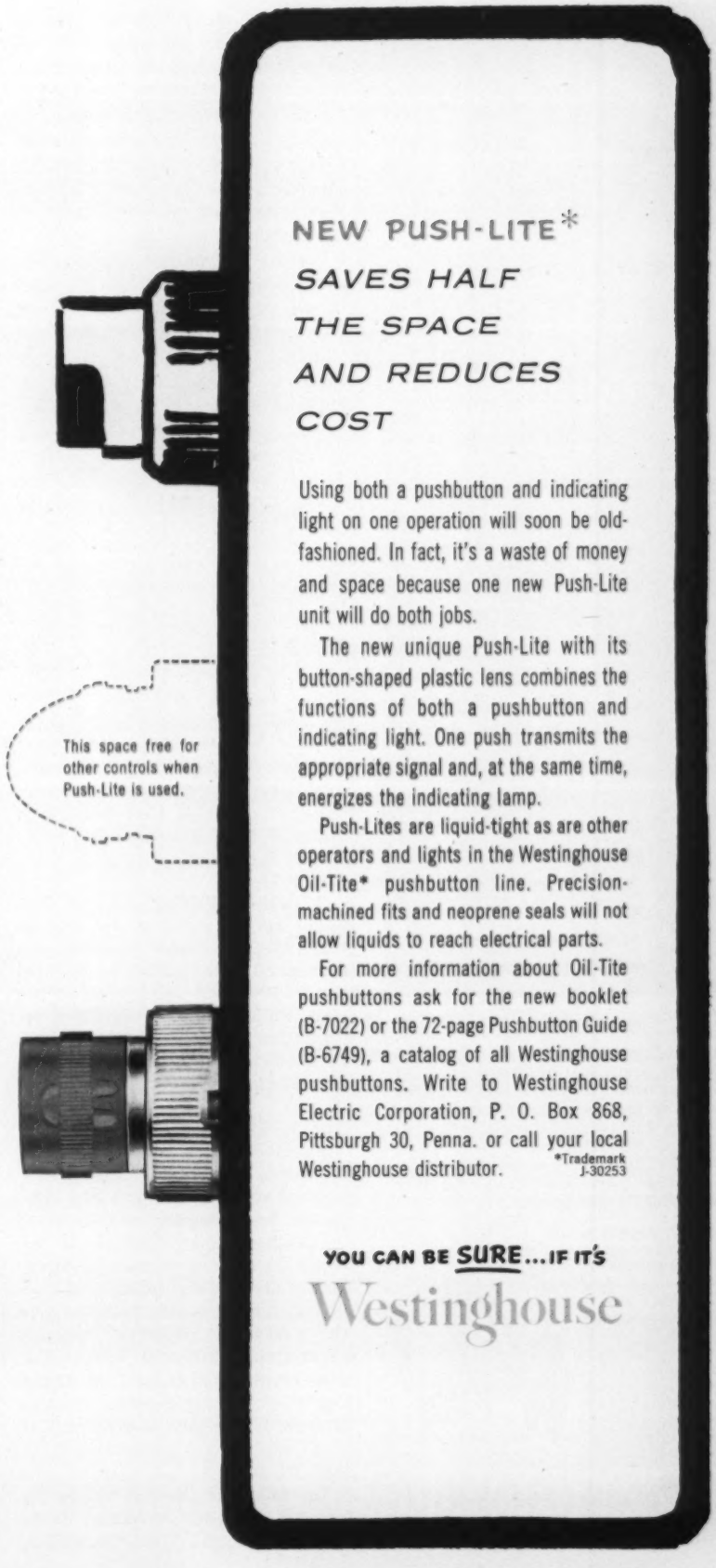
One other point requires emphasis. It has been pointed out that automation is the result of the natural and evolutionary growth of industry. If this is true, then why all the sudden interest in automation?

No doubt, **Phil T. Sprague, Jr.**, executive vice president, The Hays Corp., Michigan City, Ind., put his finger on the answer in a speech before members of the Kalamazoo Section of ISA. Said Sprague, "Our standard of living, measured by per capita production of goods and services has been rising 2.65 per cent per year (compounded annually) since 1950. The continuation of this trend means that by 1975 we'll need to produce $3900 worth of goods and services per capita for our predicted 220,000,000 population . . . that means a gross national product of $858 billion . . .

"If we accept the premise of shorter hours as a feature of the rising standard of living, it becomes obvious that there is only one way in which we can continue to raise our living standards at their present rate: We must raise our level of productivity through more and more automation—even more rapidly than at present. Enough more rapidly, in fact, to offset a potential shortage of between 9-million and 21-million workers by 1975."

Powdered Copper Processes Promise Operating Economies

ACQUISITION by the E. W. Bliss Co. of a 20 per cent interest in Chemetals Corp. has been announced. The latter corporation is a research and development organization principally concerned with the production of copper powder by chemical methods and the fabrication of copper strip, tubing and other wrought shapes directly from copper powder. Copper powder is obtained by a chemical process similar to that used in the pro-



NEW PUSH-LITE* SAVES HALF THE SPACE AND REDUCES COST

Using both a pushbutton and indicating light on one operation will soon be old-fashioned. In fact, it's a waste of money and space because one new Push-Lite unit will do both jobs.

The new unique Push-Lite with its button-shaped plastic lens combines the functions of both a pushbutton and indicating light. One push transmits the appropriate signal and, at the same time, energizes the indicating lamp.

Push-Lites are liquid-tight as are other operators and lights in the Westinghouse Oil-Tite* pushbutton line. Precision-machined fits and neoprene seals will not allow liquids to reach electrical parts.

For more information about Oil-Tite pushbuttons ask for the new booklet (B-7022) or the 72-page Pushbutton Guide (B-6749), a catalog of all Westinghouse pushbuttons. Write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. or call your local Westinghouse distributor. *Trademark J-30253

YOU CAN BE SURE...IF IT'S Westinghouse

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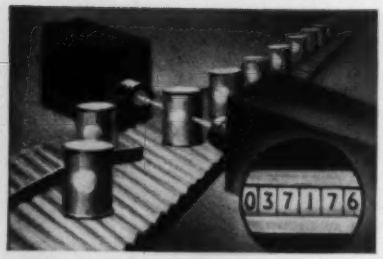
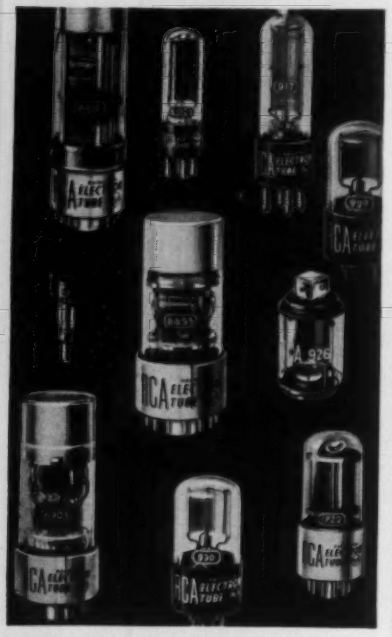


DEPENDABILITY... WHERE IT COUNTS

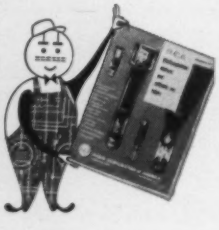
RCA Phototubes



For long-term dependability in light-actuated equipment, specify RCA Phototubes. They offer a proven record of faithful service in applications involving light measurements, scintillation counting, color matching, and sound reproduction.

RCA Phototubes are available in a variety of spectral-responses, sensitivities, and physical sizes to meet your specific needs. For quick service, call your RCA Industrial Tube Distributor.

HANDY REFERENCE 24-page book (CRPD-105) containing technical data on 109 RCA tubes—including Multiplier Phototubes, Phototubes, Storage Tubes, Cathode-Ray Tubes, and TV Camera Tubes. Free—from RCA Commercial Engineering, Harrison, N. J.



RCA **TUBES FOR INDUSTRY**
Radio Corporation of America
Tube Division Harrison, N. J.

Circle 565 on Inquiry Card

duction of nickel powder and in the production of cobalt. It involves the leaching of copper from scrap, cement, matte, blister or concentrates and the reduction of high purity copper powder directly from solution in autoclaves by gaseous means. A semicommercial plant producing powder is now in production.

Special rolling processes enable the copper powder to be fabricated directly into strip, tubing and other copper or copper alloy end products. It is not necessary to melt the powder. The ability to fabricate directly from powder avoids a lengthy series of rolling operations and annealing, with a saving in capital equipment and operating cost. The magnitude of the savings in capital equipment and operating costs are on the order of 70 to 80 per cent of the costs of conventional methods.

MANAGER of the Gage Div. of Pratt & Whitney Co. Inc., James B. Wilkie has been appointed to the executive board of the Dimensional Standards and Metrology Div. of the American Ordnance Association. The association is an educational and scientific organization engaged in activities centering around preparedness for common defense. Wilkie is in charge of manufacturing of all Pratt & Whitney gages as well as research, development and engineering programs of the gage division.

MEETINGS AND EVENTS

Apr. 8-11—

American Management Association. Annual packaging conference and packaging exposition to be held Palmer House and International Amphitheatre, Chicago. Additional information may be obtained from AMA, 1515 Broadway, Times Square, New York 36, N. Y.

Apr. 9-11—

American Welding Society. National spring meeting and exposition with technical sessions cosponsored with AIEE to be held Hotel Sheraton and Convention Hall, Philadelphia. Additional information may be obtained from R. T. Kenworthy, 12 E. 41st St., New York 17, N. Y.

Apr. 15-17—

Symposium on Systems for Information Retrieval. Demonstrations of working systems and symposium on problems and techniques —cosponsored by School of Library Science of Western Reserve University and the Council on Documentation Research, to be held on the Western Reserve campus, Cleveland. Additional information may be obtained from J. H. Shera, School of Library Science, Western Reserve University, Cleveland 6, O.

Apr. 24-26—

Institute of Radio Engineers. Seventh Region Conference to be held San Diego, Calif. Additional information may be obtained from conference headquarters, U. S. Grant Hotel, San Diego, Calif.

Apr. 25-26—

Twelfth Annual Management Engineering Conference. Cosponsored by the Society for Advancement of Management and the Management Div. of ASME to be held Hotel Statler, New York City. Additional information may be obtained from Society for Advancement of Management, 74 Fifth Ave., New York 11, N. Y.

Apr. 29-May 3—

Materials Handling Exposition. American Material Handling Society will hold conference in conjunction with show having theme "Materials Handling, Key to Automation." To be held Convention Hall, Philadelphia. Additional information may be obtained from Clapp & Poliak Inc., 341 Madison Ave., New York 17, N. Y.

May 16-17—

American Institute of Industrial Engineers. Eighth Annual National Conference and Convention to be held Hotel Statler, New York City. Additional information may be obtained from D. J. Duffy, 44 W. 96th St., New York 25, N. Y.

May 20-23—

American Society of Mechanical Engineers. Second Design Confer-

ence and Design Engineering Show to be held New York Coliseum. Additional information may be obtained from Clapp & Poliak Inc., 341 Madison Ave., New York 17, N. Y.

May 22-24—

American Society for Quality Control. Eleventh Annual Convention and Exposition to be held Masonic Temple, Detroit. Additional information may be obtained from Hill & Knowlton, 323 Republic Bldg., Cleveland 15, O.

May 27-29—

Instrument Society of America. Third National Telemetering Conference to be held Hotel Cortez, El Paso, Tex. Additional information may be obtained from H. Pruss, Federal Electronics Corp., 1136 N. Las Palmas Ave., Los Angeles 38, Calif.

June 9-13—

American Society of Mechanical Engineers. Semi-Annual Meeting to be held Sheraton-Palace Hotel, San Francisco, Calif. Additional information may be obtained from society headquarters, 29 W. 39th St., New York 18, N. Y.

June 12-14—

Illinois Institute of Technology. Operations Research Conference to be held on university campus, Chicago. Additional information may be obtained from Conference Coordinator, Illinois Institute of Technology, 3300 S. Federal St., Chicago 16, Ill.

AUTOMATION

"To operate cycling equipment in this plant requires a different kind of talent, Cecil!"

CHICAGO TRAMRAIL

TRAK-RAK cuts cost of

BAR STOCK HANDLING 66.3%

employing 2 men where 4 were formerly required . . . with 100% selectivity of material

An improved, simplified, and radically different method of handling bar stock is now in use which replaces the usual difficult and costly method of storing bar stock in pigeon hole racks and removing only a bar or two at a time.

Utilizing the TRAK-RAK Crane System, bar stock is assembled in unit loads placed in containers or baskets which are stored in fabricated tree-type racks on each side of narrow aisles. To remove one or more bars, the container is lowered to the floor, the bars removed and the container with the remaining bar stock placed back in its designated location in the storage racks. The entire movement is one-man, pendant push-button controlled from the floor and it is now possible for the saw man to select his own material and place it directly upon the saw table.

This TRAK-RAK Crane System operates in a 4 ft. 6 in. aisle and stores the material eleven high. The same crane incorporates interchangeable forks which allows the crane to handle palletized material as well as bar stock in the same area.

Write today for TRAK-RAK applications —a 20-page illustrated booklet explaining the TRAK-RAK Handling and Storage System; illustrates and describes installations for handling many diverse materials in fourteen widely different industries.

CHICAGO TRAMRAIL CORPORATION

1306 SO. KOSTNER AVENUE • CHICAGO 23, ILLINOIS

Circle 566 on Inquiry Card

Askania Regulator Company NEWS

Automatic Controls for Edge Position and Thickness, Flow, Pressure, Ratio and Combustion

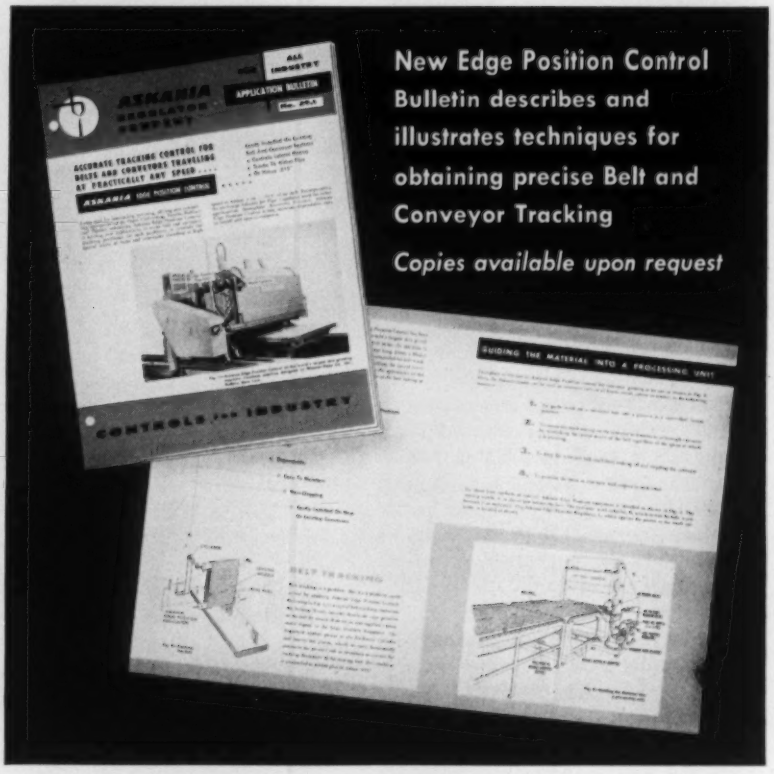
Bothered by LATERAL WEAVE of your Belts and Conveyors?

New information on Belt and Conveyor Tracking is provided in ASKANIA Regulator Application Bulletin #39.1. This bulletin is now available to anyone interested in:

1. **How to automatically control edge position when:**
   - A. Carrying material into a processing unit by means of a conveyor belt so as to deliver it at a specific lateral position into the unit.
   - B. Lateral weave of belt or conveyor must be eliminated so as to keep the material that it is carrying from falling off.
   - C. Tracking is a problem.
   - D. Lateral weave of belt or conveyor must be eliminated to permit maximum speed of operation...and/or prevent the belt itself from working off the roller.
2. **How to guide belt or conveyor at intermediate points or at other positions.**
3. WHAT makes the ASKANIA EDGE POSITION CONTROL the most effective device for eliminating lateral weave of even the highest speed belts and conveyors; easy to install and maintain; readily applicable to practically any belt or conveyor.

For example, the new bulletin diagrammatically illustrates:

- How to obtain precise tracking of high speed belts
- How to guide material into a processing unit
- How to position an intermediate steering roller to guide the belt in process



New Edge Position Control Bulletin describes and illustrates techniques for obtaining precise Belt and Conveyor Tracking

Copies available upon request

Sound, Practical Operation

Just check the Askania Edge Control advantages, listed below, which are completely described in bulletin No. 39.1. They explain why Askania Edge Position Controls provide consistently accurate belt tracking with a minimum of installation and maintenance. Askania Edge Position Controls are:

1. Non-contact—won't damage the edge of the belt or conveyor
2. Amazingly easy to install
3. Easily adaptable to *new* or *existing* machinery
4. Powerful—can position the heaviest rollers
5. Always dependable
6. Almost maintenance-free

Economy—Versatility

Bulletin No. 39.1 points out why and how these edge position controls

- Save you time and money
- Eliminate trial and error
- Permits higher operating speeds

Answers your questions

You'll probably find just the answers you need to solve your own specific belt or conveyor tracking problems in Bulletin #39.1. SEND FOR YOUR COPY TODAY TO ASKANIA REGULATOR COMPANY, 244 E. Ontario St., Chicago 11.

ASKANIA REGULATOR COMPANY

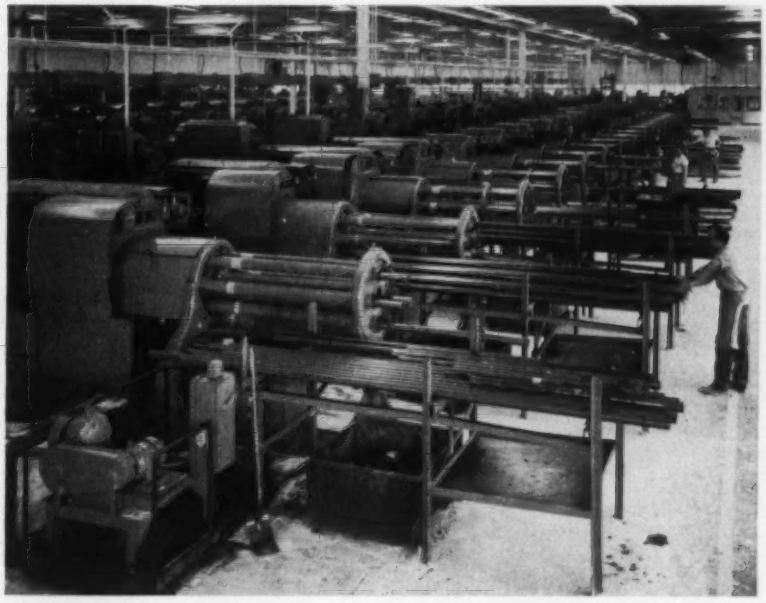
"CONTROLS FOR INDUSTRY"

HYDRAULIC, ELECTRONIC CONTROLS & SERVOS, GENERAL SYSTEMS, ENGINEERING & COMPUTER SERVICE, VALVE ACTUATORS & CYLINDERS

A SUBSIDIARY OF GPE

Circle 567 on Inquiry Card

By JAMES C. KEEBLER
Associate Editor



Tubular stock used by these machines is transferred from raw material stores (behind the camera) to this aisle by overhead bridge cranes. Fafnir Bearing Co. has 180 multisplindle automatic screw machines in this new plant which was designed by Austin Co. to produce bearing rings as the sole product.

Ball Bearing Automation

THREE OF THE GIANTS that scratch each other's backs in a mutual admiration society fashion are the three industries that make automobiles, anti-friction bearings, and machine tools.

Catch the Ring

Interdependent relationships and merry-go-round cycles of buying and selling are the stuffings of the nation's prosperous economy. GM's New Departure Div. says that nothing rolls like a ball. Machine tool builders supply equipment to manufacture bearings to a higher degree of precision. Yet, the precision of the machine spindles is limited by the precision of the bearings therein.

Since a good percentage of the ball bearings made go into automobiles the bearing manufacturers are auto parts makers. With an average of 14 ball bearings in each 1957 G.M. car having no optional equipment, and four to six more in cars with seat actuators, air conditioners, power steering, etc., the auto industry is a good bearing customer. This total multiplied by 7 million cars a year comes out to be a 9 digit number that's worth rolling for.

Automated production of high precision hardened and ground parts is an important concern to all three of these industries. Inner and outer rings are made from tubing. First operations and cut-off are performed on multiple spindle automatic screw machines.

Many a sharp "slipstick" sliding engineer has found that the small saving in cycle time in making his screw machined parts from tubing instead of bars was eaten up by the higher cost of tubing material. But the lesson for all automakers who keep an eagle eye on the cost sheets is never to dye in the wool with rules on your thumb. These bearing boys chop off so much of this tubing annually that the price is right and the savings are accrued on material costs and cycle times.

Thumbing Rules

Those who think of automation only in terms of production techniques developed since Harder first uttered the magic word *Automation* are thumbing right past a few useful rules. If we aren't careful these newly trained manufacturing engineers will be overlooking a few tricks that have been in the trade since Hector was . . .

Overpublicizing the new developments might overshadow the fact that the methods developed long ago fit the pattern of present-day automation techniques and therefore should not be overlooked in evaluating possible production processes.

A case in point is the automatic screw machine used on these bearing rings. This machine development was placed on the market in the 1890's and incorporated such sound basic automatic machine thinking that it remains primarily the same in principle in its 1957 model.

On these machines are performed in succession and without manual attention virtually all of the circular machining operations required on ball bearing rings. This is automation. Just because the technique is not new is no reason why it should not be given its just place in the galaxy of automation studies.

Galaxy of Automatics

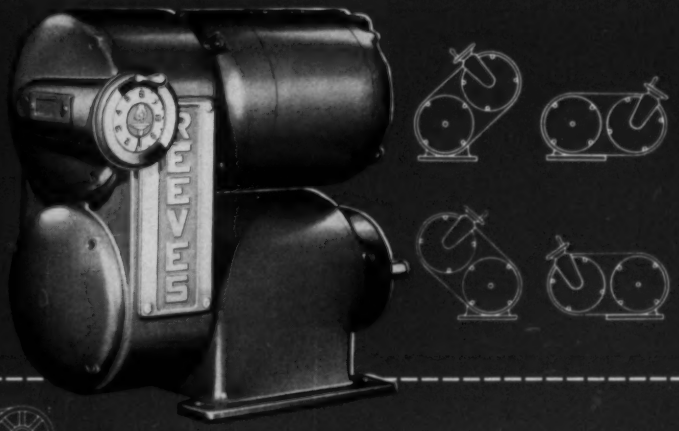
Automakers are used to large rooms full of automatics. AC Spark Plug has 70 of them under one roof in Flint making spark plug shells from hexagonal bar stock. One of the newest plants in the bearing industry is Fafnir's 220,000 square feet in Newington, Conn. that is completely devoted to the machining and heat-treating of rings for 10,000 different types and sizes of ball bearings. Here

REEVES®

the one name for all mechanical variable speed!

REEVES Vari-Speed® Motodrive

A complete power package . . . choose from over 900 assemblies in vertical, horizontal or 45° models . . . ¼ to 40 hp. . . . 2:1 to 10:1 speed ratios from as low as 3 rpm. to a maximum of 4660 rpm! Assemblies available in standard, totally-enclosed or splash-proof enclosures.

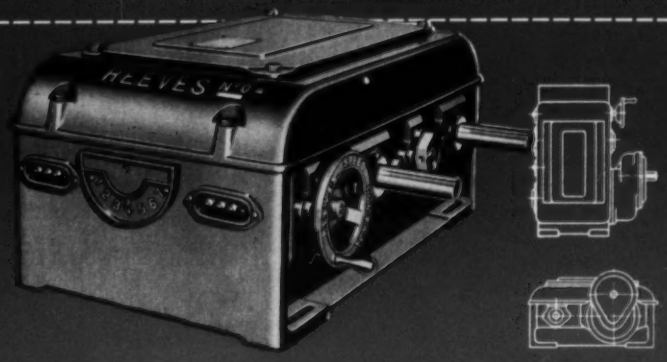


REEVES Vari-Speed® Motor Pulley

The low cost answer to variable speed advantages! Choose from 8 sizes . . . ¼ to 15 hp. . . . 1.75:1 to 4:1 speed ratio. Easy maintenance and long life assured . . . just 5 main parts. REEVES "close-grooving" lubrication insures free sliding disc for easy speed changes. Standard or countershaft motor bases.

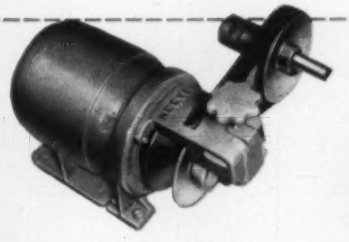
REEVES Variable Speed Transmission

Vertical or horizontal types—in open frames or enclosed cases—straight, countershaft or reducer models. Fractional to 87 hp. . . . 2:1 to 16:1 speed ratios. "Internals only", without frame or case, also available.



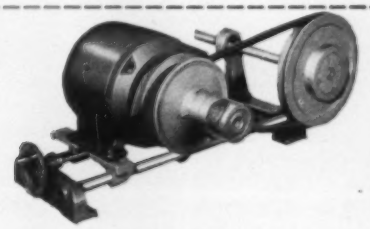
● The *complete line* in the industry is REEVES . . . adjustable speed drives and speed control for applications from ⅛ to 87 hp! The *proven* name is REEVES . . . years of trouble-free service in hundreds of thousands of installations—every industry! The *original* variable speed drive, REEVES is still the leader in its field!

Incorporate variable speed into the machines *you* design: widen the work range of the machines; insure your designs against early obsolescence; add the many operating advantages of accurate, instant speed control. Your REEVES representative—with wide and varied experience—will be glad to work with you for the *best* application . . . *best* results!



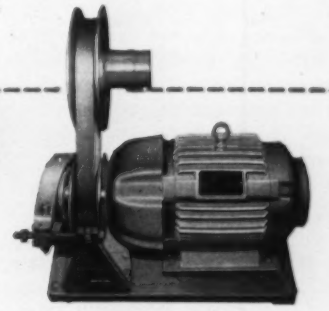
REEVES Flexi-Speed®

Two sets of adjustable discs with convenient shifting mechanism. Provides flexibility, economy to your equipment . . . easy to install. ½, ¾ and 1 hp. with 8:1 speed ratio.



REEVES Jr. Motor Pulley

Simplest form of variable speed control. 5 sizes from ⅛ to 1½ hp. capacity . . . ratios up to 2.75:1 in a speed range from 135 to 1965 rpm. Standard or countershaft bases for standard motors.



REEVES Vari-Spin®

A mill tested and proved unit to increase spinning efficiency and frame flexibility. 500 to 1450 rpm. range. Change speeds *with spinning frame in operation* . . . get required speed—in seconds!

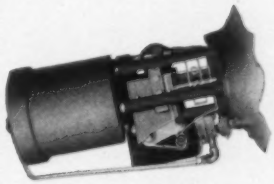
REEVES CONTROLS

Manual

Basic REEVES control on all units. "Speedial" handwheel, extended handwheel, hand chain and extended rod controls also available.

***Mechanical Automatic**

For Motodrive, Transmission. Simplest automatic control—requires shifting force sufficient to position control lever of speed changing mechanism.



Automatic (Pneumatic)

Motodrive application only. Cam-compensated design controls output speeds in direct proportion to instrument air signals.

Electric Remote

Push-button stations for single unit or battery of Motodrives, Transmissions or Motor Pulleys. AC or DC . . . full range of current characteristics.

*Also available in hydraulic or pneumatic type.

Individual bulletins—complete with rating tables and dimensions—are available for any of the above products by writing REEVES, Dept. AN-26, Columbus, Indiana.

Your REEVES representative will be glad to work directly with you. He's as near as your telephone . . . regional offices in 34 principal cities.

REEVES PULLEY COMPANY

DIVISION OF **RELIANCE** ELECTRIC AND ENGINEERING CO.

COLUMBUS, INDIANA

Circle 568 on Inquiry Card

180 automatic screw machines are set in seven rows.

In planning this layout Fafnir worked with Austin to come up with an automated system. Rather than set up lines of machines that would process in sequence all of the operations from tubing to finished bearing assemblies the decision was made to have these bar machines together in a colony arrangement.

Here the know-how of key setup men and the machine repairers could be concentrated to keep these machines on production a maximum percentage of the time. Here also the concentration of large batteries of machines would permit use of the most efficient steel, chip and ring handling systems available. Monorail bridge cranes move incoming steel bars and tubes from cars on the enclosed 360-foot railroad siding to the adjacent storage area. From this point, steel is carried as needed to individual screw machines by hoists operating on the interconnecting overhead monorail system.

Chips are removed from the machines by under-floor conveyors running in 220-foot long trenches beside each bank of automatic screw machines and converging at a central chip processing pit. Coolant removed from the chips is reused after filtering and the chips blown to an outside storage bin for collection by scrap buyers.

Belt conveyors parallel to the seven rows of screw machines carry bearing rings from the machines to transfer points where automatic lifts raise boxes full of rings to a single gravity roller conveyor system. All boxes of rings move toward a central washing station en route to second machining, hardening furnaces, and stock shelves or the shipping dock.

In the Act

It takes more than automatics to make ball bearings. One machine tool builder particularly interested in helping develop automated techniques for the bearing industry is the Micromatic Hone Corp. These are the people that recognized that with 14 ball joints on the car of the future, there was a market for a honing process that would make ball studs truly spherical. Using similar reasoning they viewed hardened and ground bearing rings as a potential market for their specialty—low velocity abrading.

Machines developed by Micromatic use stick abrasive to automatically hone ball grooves in inner and outer bearing rings. The trick is to oscillate the stick about the center of the radius of the groove as the ring spins and thereby develop true geometry of the finished groove. To keep pace with these raceways in production the machines are multistation, automatically loaded and unloaded, and feature automatic feeding of the sticks.

No matter how well you make them you've still got to check them and classify the parts for precision assembly. This company bought a Talyrond contour checker, a Waveometer and a Rotopiloter, all highly accuarte pieces of measuring equipment, to check the results of the generated groove radii produced by the machines they were developing.

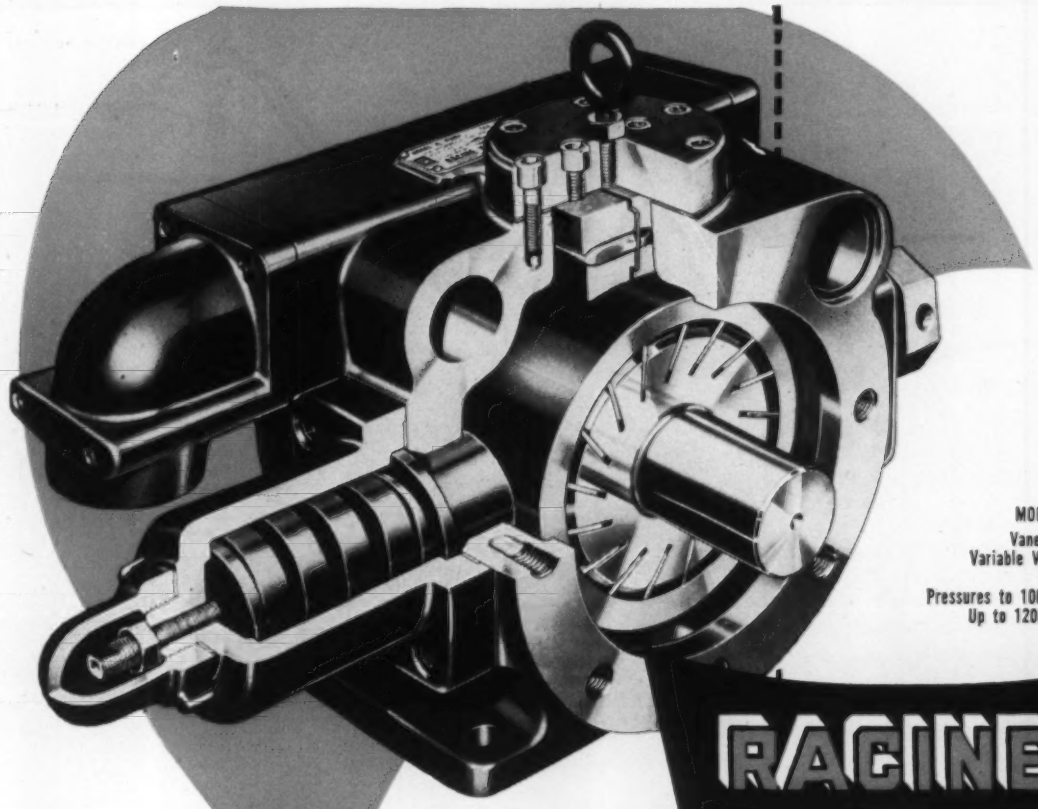
Humphrey Design Co. is working on differential gaging techniques to automatically measure an inside and an outside bearing ring simultaneously and determine the ball size necessary to produce the proper running fit. Ring sets would thus be classified into categories and segregated ready for assembly. This and other techniques under development are pointing toward more automation for an industry that is already highly automated.

A significant factor to consider is that these machine developments represent special equipment earmarked for a ready machine market in a highly specialized industry. Here we find machine builders and engineering companies applying know how they have developed in other industries to the automation of production processes in the bearing industry.

On a Par

These considerations place the bearing boys in the same league as the automaker where tire assembly equipment, piston processors, connecting rod assembly machines, cylinder block broaches and the like have been developed for sale to all comers in the industry. The technique of placing all automatic screw machines in a colony parallels the automaker's technique of placing stamping and other operations in separate divisions.

Belt conveyor by line of Acme-Gridley machines in Fafnir plant is part of system installed alongside each of seven long batteries of screw machines in the primary machining area. Filled tote boxes are automatically conveyed to a washing station, enroute to the secondary machining and heat-treating areas.



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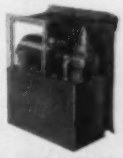

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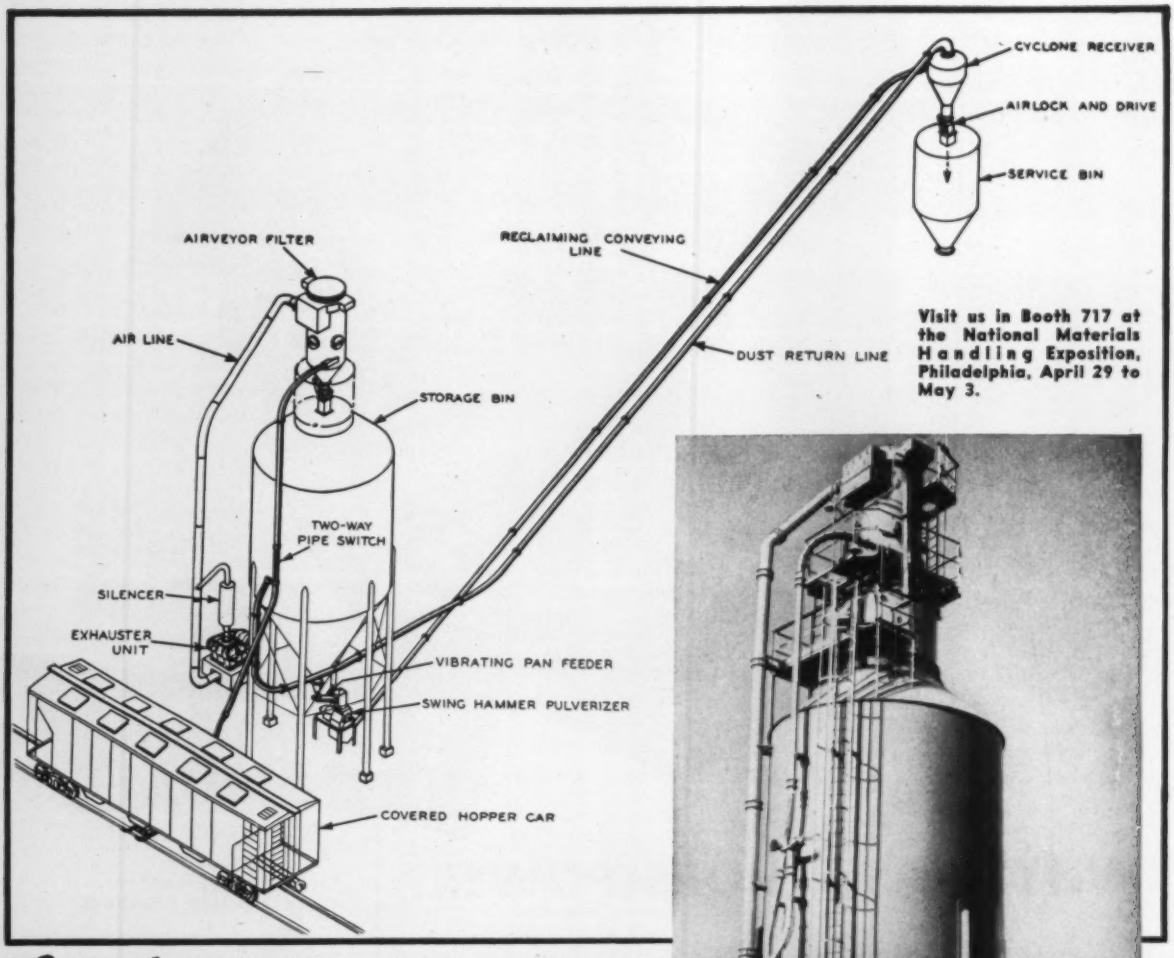

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notes from britain

By FRANK G. WOOLLARD
British Correspondent

Seventeen-station in-line transfer machine for cylinder head production. The machine, which handles both 4 and 6-cylinder heads, was produced by Asquith Machine Tool Corp., Ltd.

Versatile In-Line Machines

AS I have reported, in Britain the smaller manufacturing concerns favor the rotary indexing machine built up from standard package unit bases, heads and columns. Since most of the rotaries can take up to eight operating stations, they can handle the complete machining of the majority of small components. Nevertheless, additional operations may be required and the problem of automatically linking one rotary machine to another or to individual single-purpose machines is having consideration.

The leading automobile manufacturers have, however, sufficiently large outputs to enable them to install in-line transfer machines and to keep them busy on a two-shift system. This enables them to adopt a schedule time for changing tools—either at mealtimes or at shift break without the use of tool control boards. The writer knows of no company in Britain with sufficient demand to run transfer machines on a three-shift system.

The transfer machine is still regarded as a special, custom-built for a specific purpose but in which package units are used where possible. The beds, columns, wings and transfer mechanisms are standardized by each machine tool builder; but there is no uniform standard for these items. It is, however, recognized that uniformity would be advantageous and the British Standards Institution is investigating this matter. There is little likelihood of the standardization of the operating heads.

Typical Installation

There are in existence some large in-line machines. The Austin Motor Co. have a cylinder block line of 31 stations: but it is thought that, in general, 18 stations is enough because of the tool-changing problem.

Let us consider a typical in-line machine, built by William Asquith Ltd. of the Drummond Asquith Group, for the production of cylinder heads of five types: these comprise three 4-cylinder heads i.e. petrol, paraffin and Diesel types and two 6-cylinder heads; one for petrol, the other a Diesel type. This transfer machine is built up of bases which carry two, three or four operating heads on wing bases with a bridge piece between each main base pair, thus providing an idle station. The idle stations make tool changing easy and they can be used to carry heads for additional operations should this become necessary. Asquith supply four heads with screw-feed ranging from 2 to 10 hp and four cam feed heads ranging from 0.5 to 5 hp. Advantage is taken of the wide range of unit heads to suit them to the effort required. All the screw heads have a separate motor for the quick power traverse. The tapping heads are provided with air blast to blow out chips and oil-mist for lubricating the taps. Chips are removed by a drag link conveyor which runs in a channel in the base sections. Electro-mechanical controls are used on a 440 volt circuit and the limit switches are chosen with particular reference to their protection from the ingress of suds and dust. The transfer and clamping mechanisms are effected by hydraulic operation. The slowing up of hydraulic mechanisms due to low temperatures is no great problem in this country, and while oil leaks can be a nuisance, the latest design of fittings shows a

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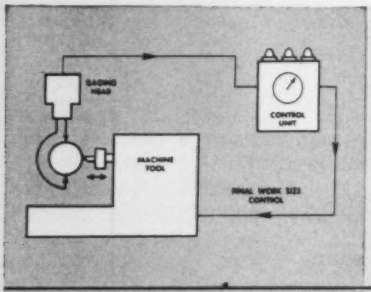
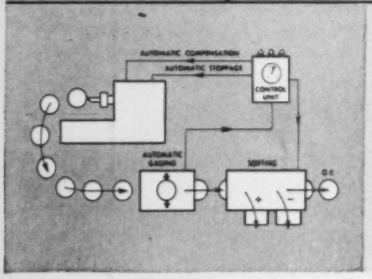


IN-PROCESS
control utilizes gage to make tool retract when part has been machined exactly to correct size.



POST-PROCESS
control provides feedback of corrective signals from automatic gage to machine to maintain part uniformity. Federal pioneered both this and "In-Process" type of control.

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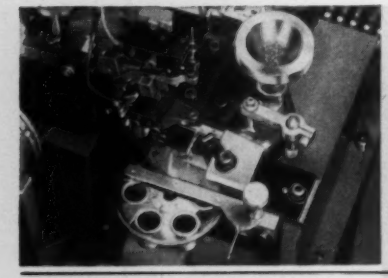

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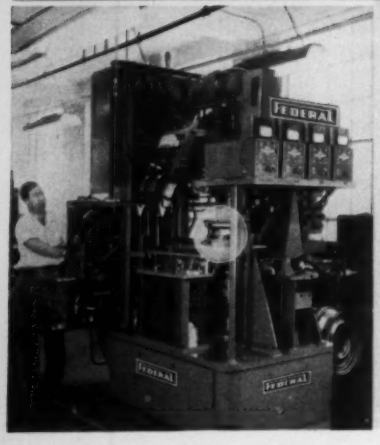

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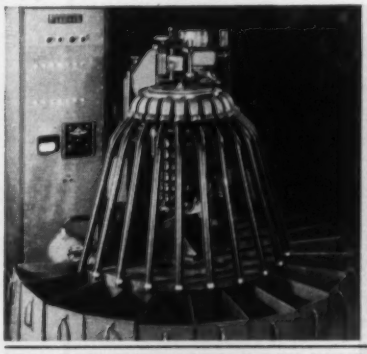

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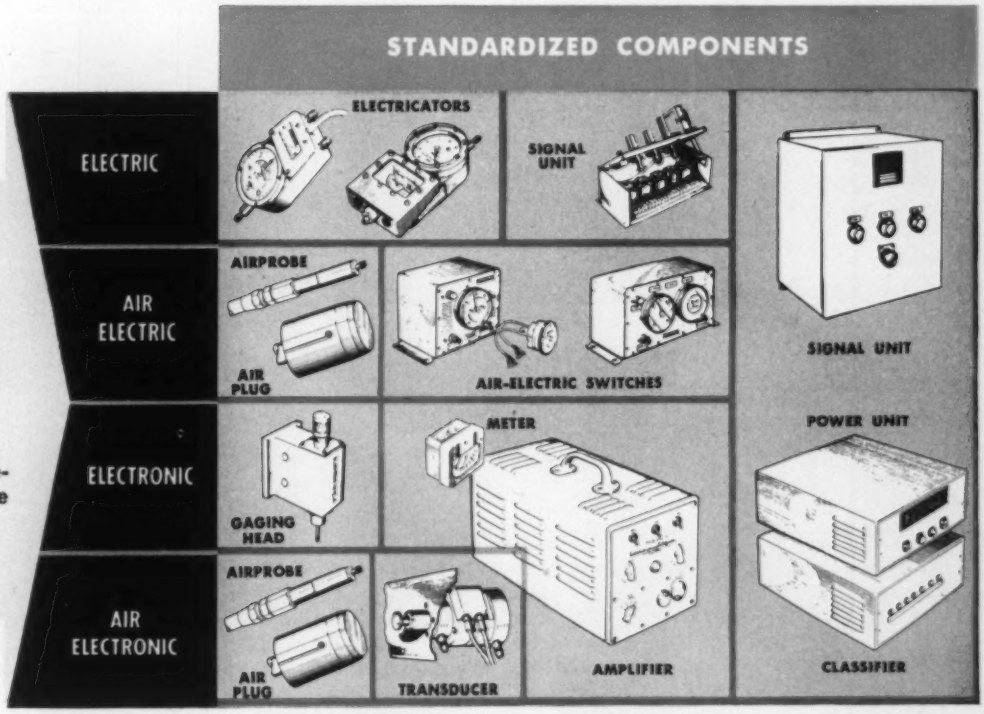

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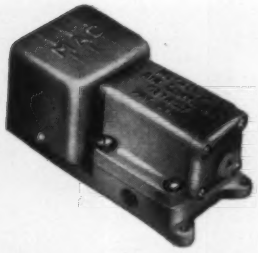

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marked improvement in this respect. Lubrication of the mechanism is by "Tecalemit" forced feed oiling.

The Austin Motor Co. are heavily committed to automation as apart from their semi-automatic assembly and their individual automatic machines, they have at least 150 rotary indexing machines and 60 in-line transfer machines. They say that these installations are no more costly than general purpose plant which would achieve the same output. These machines are all built from interchangeable bed sections, wing bases and columns so that additional operations required by a change of design, present no great difficulty; the Austin Co. make their own operating heads. Again Austin are developing means for the automatic handling of workpieces in and out of rotary machines and general purpose machines. In general they claim that advantages obtained from the new plant are increased production, lower costs per piece, controlled and more uniform quality, economy of factory space, reduction in inventory and last, but not least, less fatigue and greater safety for operators.

Drilling, tapping and reaming of cylinder heads is performed on 19-station in-line transfer machine. As shown, heads are carried in fixtures mounted on platens. Later machines require platens only for awkwardly shaped workpieces. This equipment was developed by Austin Motor Co., Ltd.

Design Problems

As to their experience in operating this plant, they have found that limit switches are vulnerable to oil, suds and moisture, small chips and dust. They have cooperated with their suppliers to overcome this by greater protection and have also reduced the control circuit from the normal 440 volts ac to 50 volts dc. The fast traverses have given occasional trouble by over-running. This has been cured by supplementing the motor brake with a clutch which virtually ensures the instantaneous reduction of the kinetic energy to nil.

In earlier machines Austin were committed to platens but in later types the platen is only used for mounting the fixtures which carry the awkwardly shaped pieces. This, of course, saves not only the quite considerable expense in providing the platens but also saves labor in loading, unloading and cleaning the platens. Moreover they claim greater accuracy in locating the workpieces. Again when the work goes bare there are less problems in the presentation of the tools and rollover is more easily effected. Where platens and fixtures are essential they are, in the later type machines, returned through the wing beds being cross-indexed, lowered by a powered lift, cleaned in their conveyor passage by compressed air or in a suds bath: then again cross-indexed and lifted to starting position.

In seeking to provide more rapid transfer there is always a possibility of the workpiece overrunning its location. This has been overcome by a positive location of the bare workpiece, or the platen, on the transfer bar. Cutting tools are changed on a scheduled basis at mealtimes or shift changeover. Very careful analyses have been made of the life of tools between sharpening operations. To ensure that there can be no broken drill left in a tapping hole, the hollow probe is used. Also, Austin have introduced a new method consisting of a coil, mounted on the bush plate and surrounding the end of the drill in its retracted position. If the drill breaks, the characteristic of the coil without a core changes and this gives a signal which stops the machine and shows the location of the fault. The coils are embedded in a hard plastic which is impervious to oil, suds and moisture. Austin are of the opinion that electronic control is the ultimate answer in machine shop automation and they have done some remarkable research in this direction.

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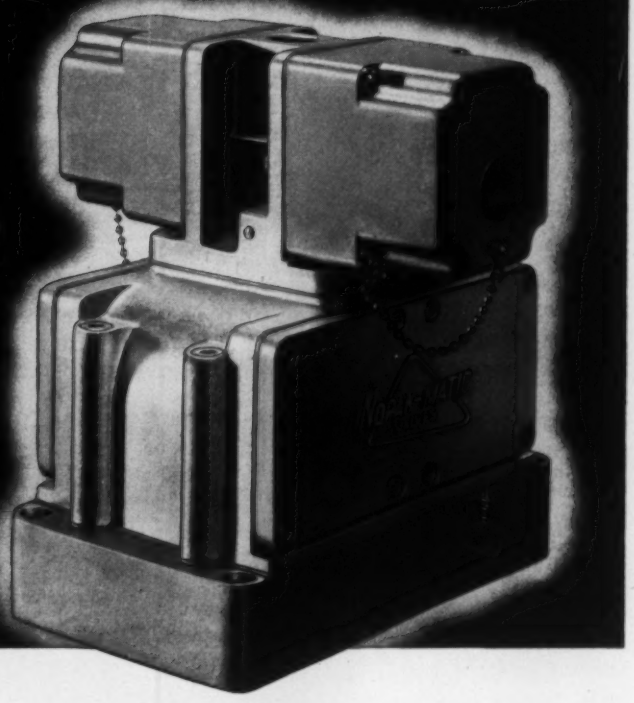

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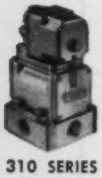

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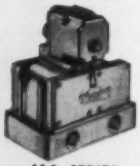

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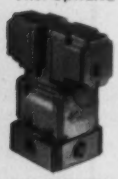

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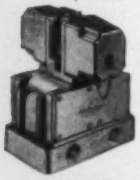

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Seeds of Thought

Congress' second series of Hearings on Automation and Technological Change, held in Washington in December, was an extension of the 1955 study and covered the process instrumentation role in automation. The original idea in conducting such Hearings was to investigate the trends in automation within industry and insure against creating mass unemployment by too rapid an advance.

The second meeting bears out the good results of the first but, unlike the first, has emphasized a major obstacle to rapid advance, perhaps even to desirable advance. This obstacle is lack of education in the broad field of automation technology. Robert T. Sheen, past president of the Instrument Society of America pointedly stated: "The need for scientific and engineering personnel is particularly pressing in the field of instrument-automation users and manufacturers . . . the Foundation for Instrumentation Education and Research was formed this year and ISA has budgeted $50,000 to start work." And instrumentation is but one phase of the broad area of industrial automation—other areas are even less well advanced!

Further testimony stressed another important factor—management appreciation of the possibilities. In the words of Thomas R. Jones, president, Daystrom Inc., "Automation is severely hampered by inadequate appreciation and understanding of its capabilities." Needless to say, successful application to a worthwhile degree follows in the wake of appreciation and understanding.

Consensus of the latest testimony, in general, indicates there may be cause for concern that we may fail to hold the line on costs in the immediate future. Automation can help, but time and knowledge are important factors. More intensive study of automation techniques is needed. Corroborating this consensus is a recent statement by General Electric accompanying a rise in lamp prices:

"Although General Electric's lamp plants have long been recognized as leaders in mechanization, it is virtually impossible to develop, build and install new types of machinery fast enough to effect manufacturing economies which would offset increasing costs of labor and materials."

Automation does not grow of itself. Meticulous care and feeding is necessary. We cannot expect to reap a harvest unless the seed is sown. Industry has a responsibility to understand and employ automation to the fullest practical extent if we are to realize our aims of increased living standards and job levels in the years to come.

EDITOR

AUTOMATION

Described here is an organization structure of the type that is behind today's achievements in automation. Approach, placement, personnel and procedure are the four keys to a successful program. Consideration of the details pertinent to each is valuable to those getting started and those underway.

ORGANIZING FOR

DEVELOPING AUTOMATION EQUIPMENT

By **JAMES J. LAHM,** Equipment Development Engineer, Westinghouse Electric Corp., Sharon, Pa.

WE ARE LIVING in the age of automation. Although today's automation will probably not overshadow its forefather, the industrial revolution, no one can deny that it is deeply affecting our lives. To consumers it means getting better products at a lower cost, while to labor it means better and safer jobs.

Engineers and managers know that behind every success in this field there was hard work and possibly disappointment. Not every venture has a happy ending. Many manufacturing companies, both large and small, have made significant progress in raising their level of automaticity. Out of this experience, basic principles which tend to earmark success can be singled out. These can be categorized as:

Approach
Placement
Personnel
Procedure

Although no panacea is claimed, the ensuing discussion of these points may be helpful in setting up an automation program for the development of special equipment. If such a program is already functioning these ideas can serve as a comparison or a review.

Approach

What are the various means of action that can be included in such an automation program? A general classification can be made as follows: (1) Establish an equipment development section, (2) contract with equipment suppliers, and (3) employ automation consultants. Many companies have found that a combination of all three approaches is most effective. Each of these has advantages which are outlined in TABLE 1.

The equipment development section should be the backbone of the automation organization. This group not only develops and constructs special machines, it provides the talent to work with and

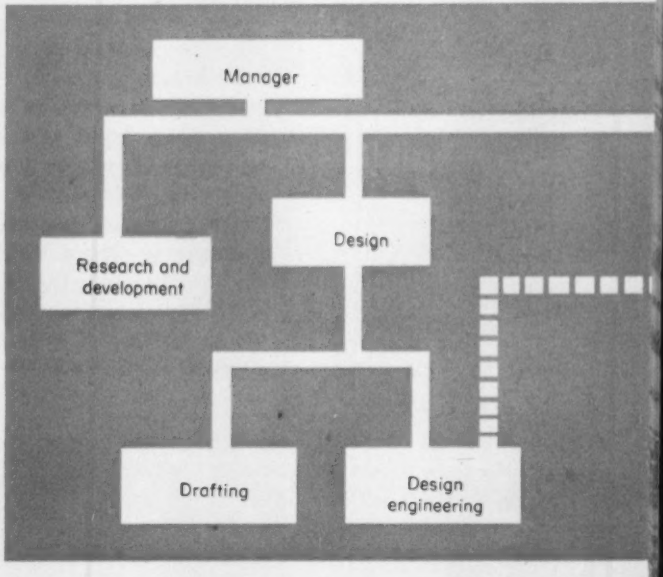


TABLE 1—Approaches to Automation

	ADVANTAGES	DISADVANTAGES
Automation Consultants	• Practical for fluctuating equipment development loads • Effective when equipment is needed quickly • Broad experience available	• Relatively expensive • Services of competent firms not always available
Equipment Suppliers	• Effective for standardized equipment • Practical where extensive facilities required for fabrication	• Outlook on problem may be too narrow • Responsibility divided
Equipment Development Section	• More familiar with vagaries of products • Available for consultation on other projects • Experience retained within company • More effective follow-up of project	• Not suited to greatly fluctuating equipment development loads

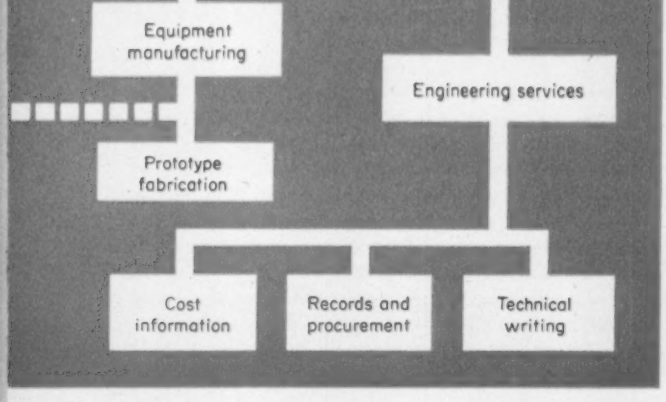
co-ordinate the activities of suppliers and consultants. Without a strong and well-staffed group of this type, an automation organization is likely to be inefficient and ineffective.

The equipment supplier and the consultant also have their place in this picture. The equipment supplier generally wins favor when the needed equipment is standardized with respect to its general function but a variation in design is required. Some examples of these might be: conveyors, riveting machines, brazing machines, induction heaters, and welders. The consultant, on the other hand, is most useful when the project is extensive and can be defined as to ultimate performance. He can also be employed advantageously when new equipment requirements are heavy, such as during model changeover periods.

When contracting with outside firms, care should be taken to clearly define the various areas of responsibility. Misunderstandings quite often involve the obligation for debugging a machine, or the interpretation of "satisfactory operation." For satisfactory performance, it is much wiser to rely upon the outside firm's reputation rather than the explicitness of the contract.

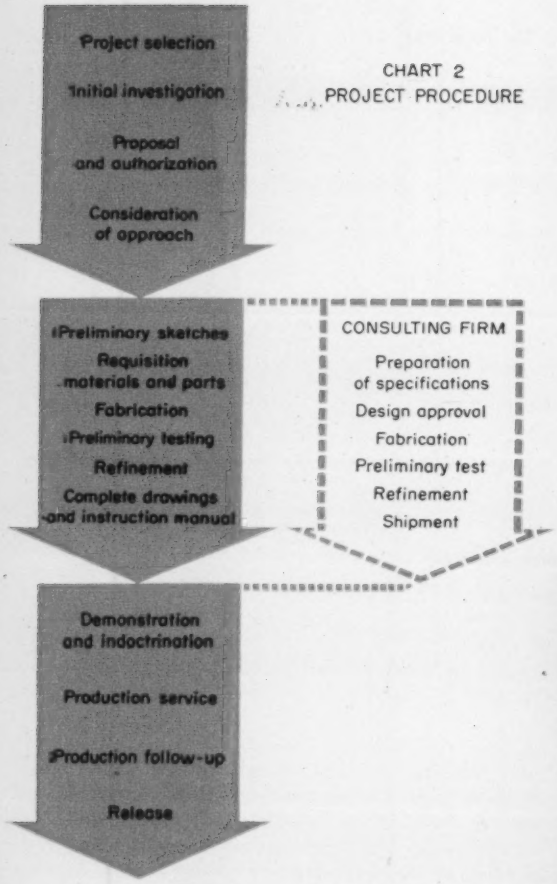
Since each piece of special equipment should be justified economically, cost as well as performance becomes a prime consideration. A well organized equipment development department affords a relatively low cost means of engineering and building a large percentage of this equipment. With this department as a foundation, each machine or project can be evaluated, individually, to determine which of the three approaches is most suitable.

CHART 1 - TYPICAL ORGANIZATION OF EQUIPMENT DEVELOPMENT SECTION



▶ Placement

If the equipment development section is to be effective in reducing manufacturing costs, careful consideration must be given to its location within the organization. Quite often the head of this group will report to the head of manufacturing engineering. Since close co-operation will be required from product engineering, the managers of these two engineering groups should be on the



same organizational level. Many companies require their manufacturing engineering department to approve new product designs giving them, in effect, the power to veto. If product design cannot be directly influenced, a high potential source of savings is being overlooked.

Since automation is so closely related to product design, some companies place their equipment development section alongside of their product development group, having both heads report to the director of development. The two are certainly akin as both activities require creative thinking, model making, and experimentation. Although paralleling these sections may have some advantages, it would be definitely unwise to combine them. Floor space permitting, it is often possible to avoid the duplication of expensive shop facilities by expanding existing facilities and using the results co-operatively. Due to the close working relationship between the equipment development section's engineering and fabricating personnel, these two groups should be located as near as possible to each other. Over-the-shoulder instructions often become a practice.

Corporations with decentralized activities sometimes go a step further with their organization. When the individual divisions manufacture different lines of products, it is better for each to have its own equipment development group. The headquarters or central operations group can then serve as a consulting firm to, and as a liaison group for, the divisions. In large corporations it is not uncommon to have several specialized groups of this type.

Although placement of the equipment development section within the manufacturing engineering organization will normally be the best choice, the location of this department should be determined by: (1) The existing organization, (2) existing facilities, and (3) existing personnel.

▶ Personnel

If a factor of this equipment development organization were to be singled out as the most important, it would be personnel. It is true that top-notch personnel are difficult to get; settling for less, however, is like starting an inning with two outs. CHART 1 outlines the functions that are involved. Some of these deserve individual discussion.

When manual operations represent a high percentage of the total, they can often be minimized by paralleling stations such as is done in this transformer coil winder. After the "stick" is complete, it is sawed into individual coils.

Administration. Being responsible for the section's operation, the manager's most important job is to get maximum performance from those who work for him. This man, in addition to the qualities normally required of an engineering administrator, should have a good understanding of manufacturing processes, equipment design, and product design. Chief Automation Engineer or Section Manager are titles which would apply to this position.

Engineers. Technical ability, aggressiveness, and the desire to assume responsibility are attributes that characterize a good engineer. To successfully fill these positions an engineer should have the additional quality of "gadgeteeringability." Men possessing this quality are optimists and thrive on the challenge of creating equipment that will perform specific operations faster, safer, and more reliably than is possible by manual means. A background of experience in electronics, hydraulics and machine design is also very desirable. There is probably no other field that offers a greater challenge. These engineers, along with the craftsmen, make the equipment development department tick.

Craftsmen. As the men who actually build the equipment, the craftsmen are an important part of the group. Each should be proficient as either a machinist or an electronic technician, and should have a working knowledge of fluid power, mechanics, electric controls, and electronics. This diversified knowledge is required because, in some cases, all of these elements are combined in one machine. These men should be expected to make minor design contributions and should be able to work from pencil sketches. Keeping the interest of these men keen is important; routine and repetitive work will only breed boredom.

Staff Functions. The need for staff specialists becomes apparent as the size of the group increases. These specialists might include: an industrial engineer or cost estimator, a records assistant, and a technical writer. Their job is to work with the engineers so that the latter can devote more time to development and design.

If the required personnel cannot be found, an extensive training program may be necessary. Talented personnel represent an investment which should be protected by providing a proper working environment. Adequate equipment, complete co-operation, and a patient management are the elements required.

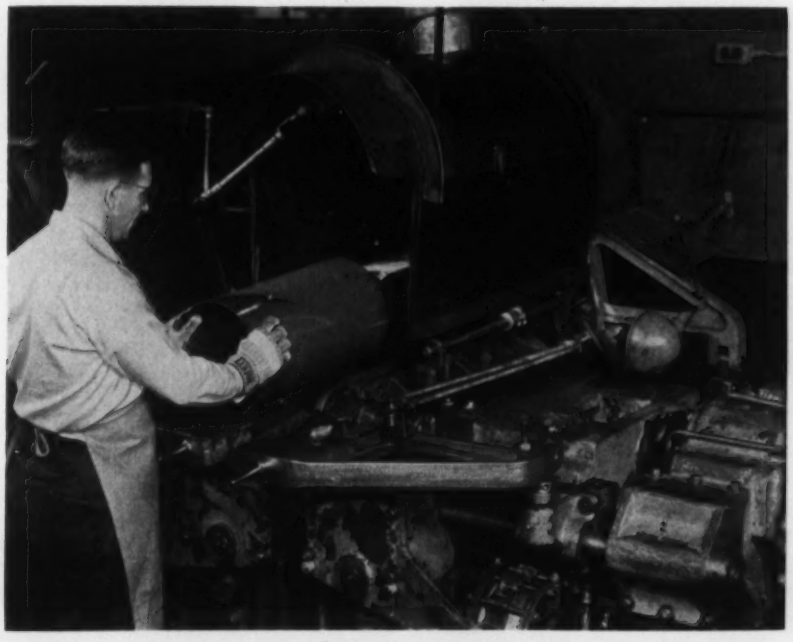
▶ Procedure

The entire responsibility for a project is normally assigned to one engineer. He should follow it through, either performing or directing all of the operations that are outlined in CHART 2.

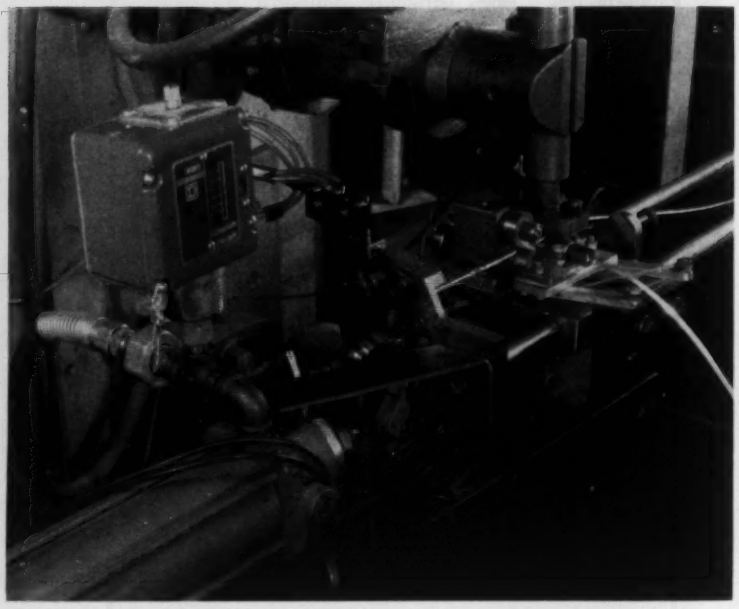
The selection of projects is seldom a problem. "Trouble spots" characterized by high costs, excessive worker fatigue, or a high rejection rate, are usually worthy of consideration. The foremen, the industrial engineers, and the quality control people can all help in this matter.

After choosing a project, an engineer makes an initial investigation with the help of the cost estimator. A proposal containing estimates of costs and savings is then submitted to a management committee for approval. Since any improvement or piece of equipment must be justified economically, the use of conservatism in this proposal is recommended. It must be stressed here that any cost estimate should contain at least a twenty per cent factor to cover the cost of refinement or debugging.

At this point the manager and the engineers confer to determine which approach to the project is the most practical. If a decision is reached in favor of the consultant, specifications are prepared so that a contract can be let. When extensive development is required it is usually better to write the initial contract to cover only the development



It is sometimes practical to purchase a standard machine and modify it for a specific application. This seam welder reduces operator fatigue and increases operator safety.



Automatic machines often improve the quality as well as the rate of an operation. This prototype machine solidifies and cuts to length stranded cable shunts for use in circuit breakers.

work. This arrangement minimizes the risks involved by providing a check point where progress can be evaluated. It is the appointed engineer's responsibility to work with and keep abreast of the progress of the consultant.

When it is decided that the project is to be kept within the company, a different procedure is followed. The engineers hold a meeting or brainstorming session to bring out as many pertinent ideas as possible. This type of joint effort, whether impromptu or at prearranged meetings, should be practiced at all stages of the project. Following this, preliminary drawings are prepared, materials are requisitioned, and fabrication is begun.

At this stage, ideas are transformed into realities. Often it is not practical to reduce these ideas directly to finished engineering drawings. In these cases, preliminary sketches and a general layout are made so that the craftsmen have a basis from which to work. The placement of all major components, schematics, and as many details as possible should be included in these original drawings. Under the technical direction of the engineer, a group of craftsmen develops and constructs the prototype model. A close working relationship at this stage is important to an efficient operation.

After fabrication is complete, the new equipment is given a preliminary test which should uncover many of its defects. The correction of these "bugs" should not be considered an additional expense. They are inevitable in any new development and should be provided for in the original estimate.

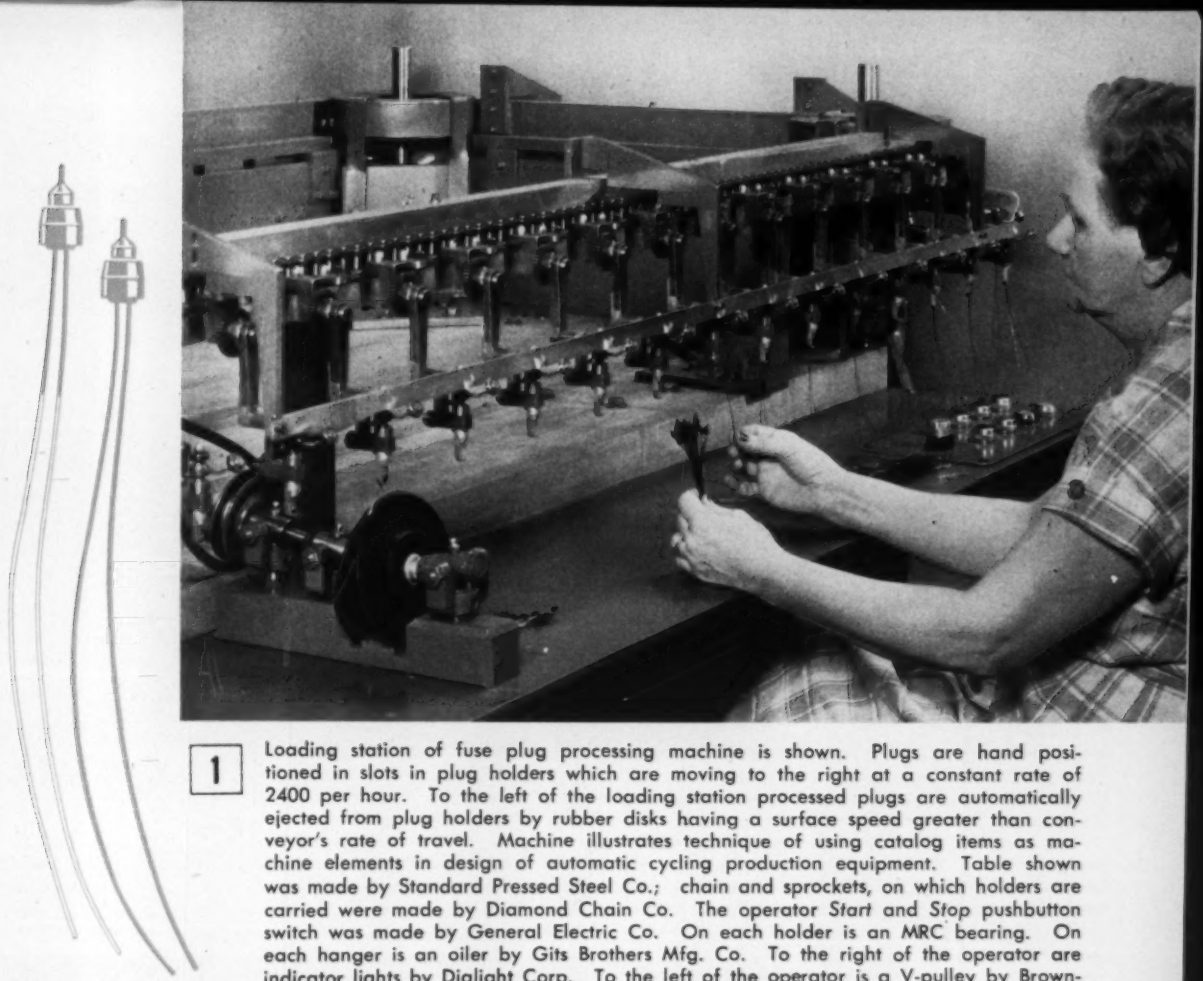
If possible, a pilot area where machines can be operated under production conditions should be provided. Since defects have a habit of not showing up at first, a thorough tryout equivalent to about two weeks normal service should be given. During this time, any operators that may be required should be instructed in the machine's operation. Likewise, it is a good practice to give the foreman, the maintenance men, and other affected parties a chance to become acquainted with the new equipment. The purpose of this is to get the new equipment into production service with the minimum amount of disorder.

To be successful, an automation program must depend upon top management as well as engineers. Encouragement, patience and guidance should be their contribution. In short, the concerted efforts of all, from the shop worker to the president, are required if maximum gains are to result.

What's Your Problem?

DO YOU have a knotty problem in your automatic operations or those you plan to install? Perhaps our experience and knowledge of this field can help establish contacts leading to practical solutions.

To avail our readers of automation information and tap the vast reservoir of practical know-how across industry, the editors have been performing a special service. If, in planning new automation systems, unfamiliar or new requirements present obstacles, write us concerning your needs and we shall be glad to assist in procuring pertinent data on present practices or in ascertaining suitable equipment obtainable from industrial specialists and consultants. We have been able to help in solving many problems, perhaps we can help you in yours.



1 Loading station of fuse plug processing machine is shown. Plugs are hand positioned in slots in plug holders which are moving to the right at a constant rate of 2400 per hour. To the left of the loading station processed plugs are automatically ejected from plug holders by rubber disks having a surface speed greater than conveyor's rate of travel. Machine illustrates technique of using catalog items as machine elements in design of automatic cycling production equipment. Table shown was made by Standard Pressed Steel Co.; chain and sprockets, on which holders are carried were made by Diamond Chain Co. The operator *Start* and *Stop* pushbutton switch was made by General Electric Co. On each holder is an MRC bearing. On each hanger is an oiler by Gits Brothers Mfg. Co. To the right of the operator are indicator lights by Dialight Corp. To the left of the operator is a V-pulley by Browning Mfg. Co. driven by a belt by Gates Rubber Co.

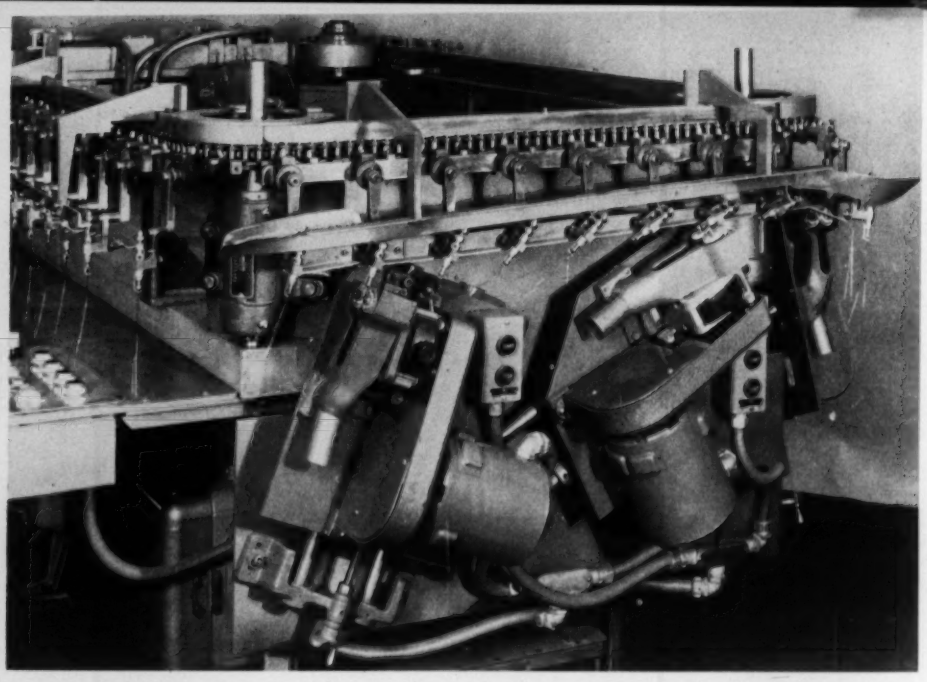
AUTOMATION TODAY

STRIPPING AND TINNING WIRES

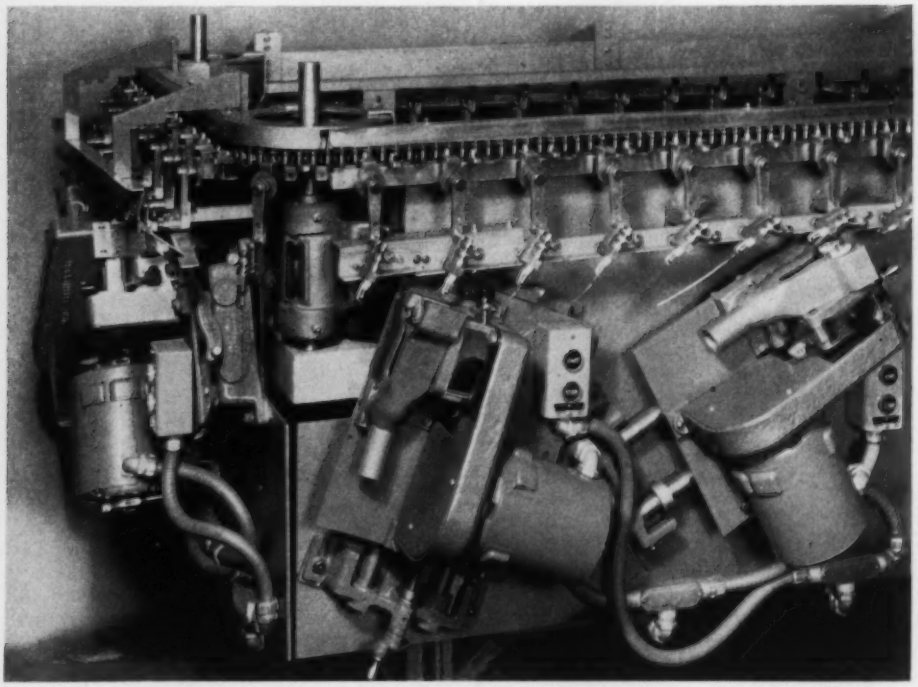
By WILLIAM WENTWORTH and VIC GOYER
Chief Engineer and Project Engineer, The Eraser Co. Inc., Syracuse, N. Y.

PERFORMING a single operation of a manufacturing process automatically may place that operation out of character with the succeeding operations. Where a series of operations can be performed with like fixturing or simple reorienting of the parts it may be advantageous to combine those operations into a single machine designed for continuous production. Where such a piece of equipment can be developed largely from stock items available, a highly economical combination can result. An example of such an instance is the fuse plug processing machine developed by the Eraser Co. Inc.

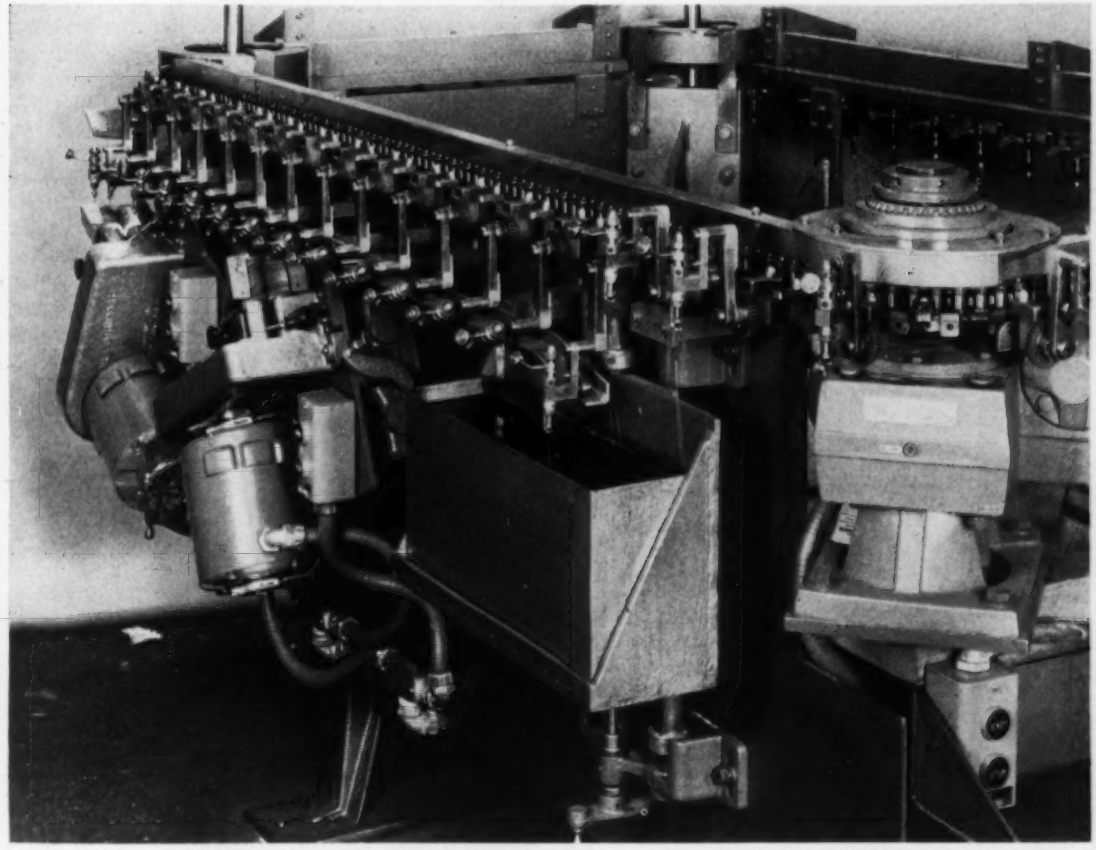
Fuse plugs being processed on this machine consist of two insulated wires which have been twisted together and molded into a small plastic plug. At the time of molding, the wires project from the top end of the plastic only a short distance and are later ground or cut off approximately flush with the plastic part. An electrical current can be caused to jump across this minute gap and thus serve to ignite a detonator or similar explosive



2 At the left, plug holders leave a guide-rail and a spring plunger drops down over top of plug and anchors it in plug holder. Plug wires are then drawn through and between Rush wire stripping machines to remove insulation. First stripper cleans upper portion of the wires and second stripper cleans lower portion. Additional catalog items are shown. Wheel type strippers were made by the Eraser Company Inc., designers of this machine. Adjustable slide mountings are by Gerbing Mfg. Corp. *Start* and *Stop* pushbutton switches and motors on wire stripping machines are by General Electric Co. Vertical bearings and pillow blocks supporting conveyor chain were made by Dodge Mfg. Co.



3 To insure removal of all insulation from all sides of the two wires each holder rotates 90 degrees and passes through two more wire stripping machines. Vertical adjustment of stripping machines is required only in the event that length of stripped portion of wires needs to be changed. Electrical supply lines to stripping machines are in flexible conduits made by Universal Metal Hose Co.



4 After leaving stripping operations, wires drop into tank containing flux and are picked straight up out of the flux. As material is consumed tank is raised by slide mechanism made by Gerbing. This is the only unit that requires manual adjustment during course of machine operation. Each workpiece holder is fastened to a main arm mounted to a gear which pivots in a bracket on the chain. As each gear engages a short rack mounted above the flux tank the main arm swings up, withdrawing the wire. A spring-loaded ball in the bracket seats in detent holes that are 180 degrees apart in the gear face. This keeps the arm vertical in either *Up* or *Down* position until rack is engaged. Gears and racks were made by Boston Gear Works. Balls were supplied by SKF Industries Inc.; springs by Merchants Spring Corp. At the right of the picture is a slip clutch made by Hilliard Corp. and a ratio motor by Boston Gear Works.

charge. The longer wires extending from the bottom of the plug are used to connect the fuse plug to a source of electrical current.

These wire ends must be tinned with solder for the purposes of facilitating the electrical connection. To do this it is first necessary to remove the insulation. The former method was to manually hang the wires in a liquid chemical or acid solution for some extended time. After the insulation became soft it was manually wiped off. In following operations the stripped wires were spread apart and then manually placed in a flux bath and from there manually dipped in a tinning pot where the operator, wearing gloves, would wipe off the excess solder on removing the wires from the pot.

Stripping techniques using conveyorized workpieces and the Eraser Company's Rush wire stripping machines have been perfected to increase the rate of production on such a wire stripping operation. The machine designed to handle these fuse plugs not only performs the stripping operation but also fluxes, tins and wipes the wires on a continuous basis.

Parts are manually loaded to holders on arms mounted on a chain that moves around the perimeter of a rectangular table. Wires pass automatically through four stripping machines and are dipped into a flux tank, then into a solder pot for tinning and immediately wiped and returned to an automatic unloader beside the operator's station.

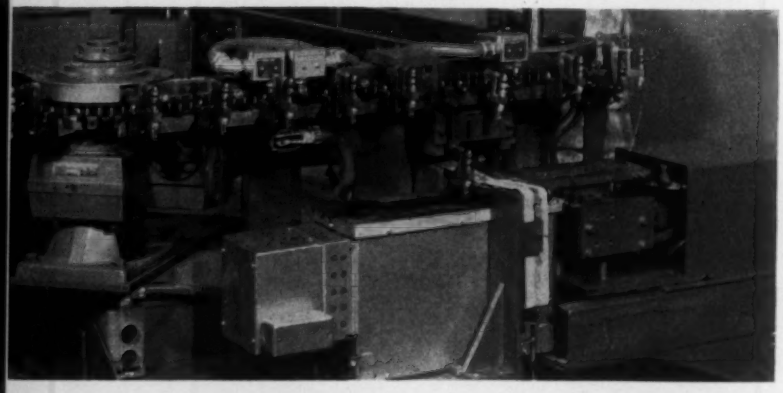
Electric circuits on this machine include interlocks to safeguard automatic operation. Three of these will stop the machine if an arm is in the wrong position before entering either the tinning operation or the unloading station. Other inter-

locks prevent the wires from being jammed between wiping belts when the machine is started.

In designing special machines, we try to use standard catalog items to the greatest extent possible. Normally available from stock, such items save design time and keep manufacturing costs at the lowest possible level. Proved components can be combined to obtain a dependable piece of equipment with good appearance and performance and without resorting to design of the complete unit from "scratch."

In this regard it is of interest to note the list of suppliers whose products have gone into this fuse plug processing machine. These parts and their manufacturers are identified in the captions of the accompanying photos that show step by step how the machine works. Catalog items in addition to those listed with the pictures include: Electric control relays made by Allen-Bradley Co.; panel box by General Electric Co.; fuses by Bussman Mfg. Co.; lacquers by Ditzler Color Div. of Pittsburgh Plate Glass Co., and Strathmore Products; steel rods by Crucible Steel Co.; cap and set screws by Allen Mfg. Co.; and washers by Shakeproof, Inc.

Net result of this development is a processing machine that can handle the required operations continuously at the rate of 2400 parts per hour.



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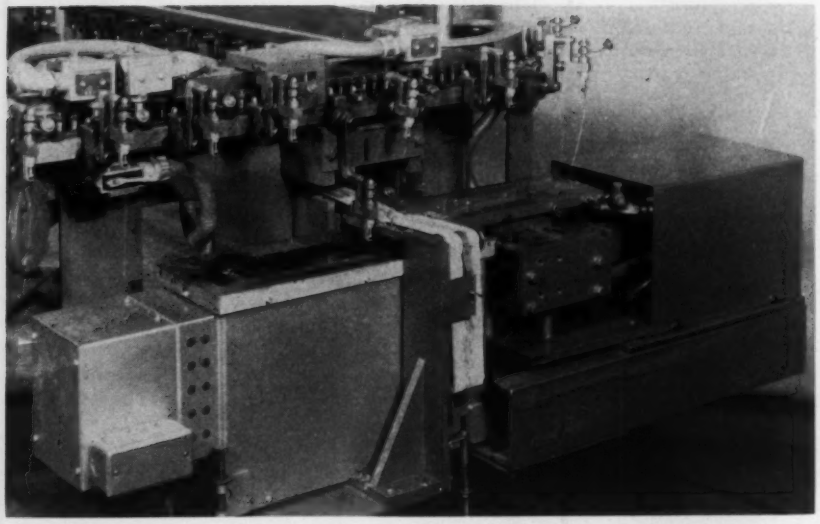
Fluxed wires are dipped into molten solder by rotating the main arms back into *Down* position. As arm rotates up again, pulling wires out of pot, a wiping mechanism brings split deerskin belts into contact with wires insuring removal of excess solder and separating the wires. Solder pot with thermostat controls was made by Dee Electric Co. and above it are switches made by Micro Switch.



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Closeup view of tinning and wiping station shows wiping belts which are opened and closed as wires approach. Air controls at right jog belts to provide a fresh wiping space for each pair of wires. This actuation is accomplished by an air cylinder made by Hannifin Corp. and a solenoid valve arrangement comprised of units by Galland-Henning Mfg. Co. and by Skinner Electric Valve. Wiper belts were made by Syracuse Elbridge Co. Visible in the picture is a Schrader flow control valve. After holders turn corner shown here, arm is lowered by another rack. Spring plunger engages cam surface on guide rail shown in *Fig.* 1, and unclamps plug ready for eject disks to unload holder and complete the cycle.

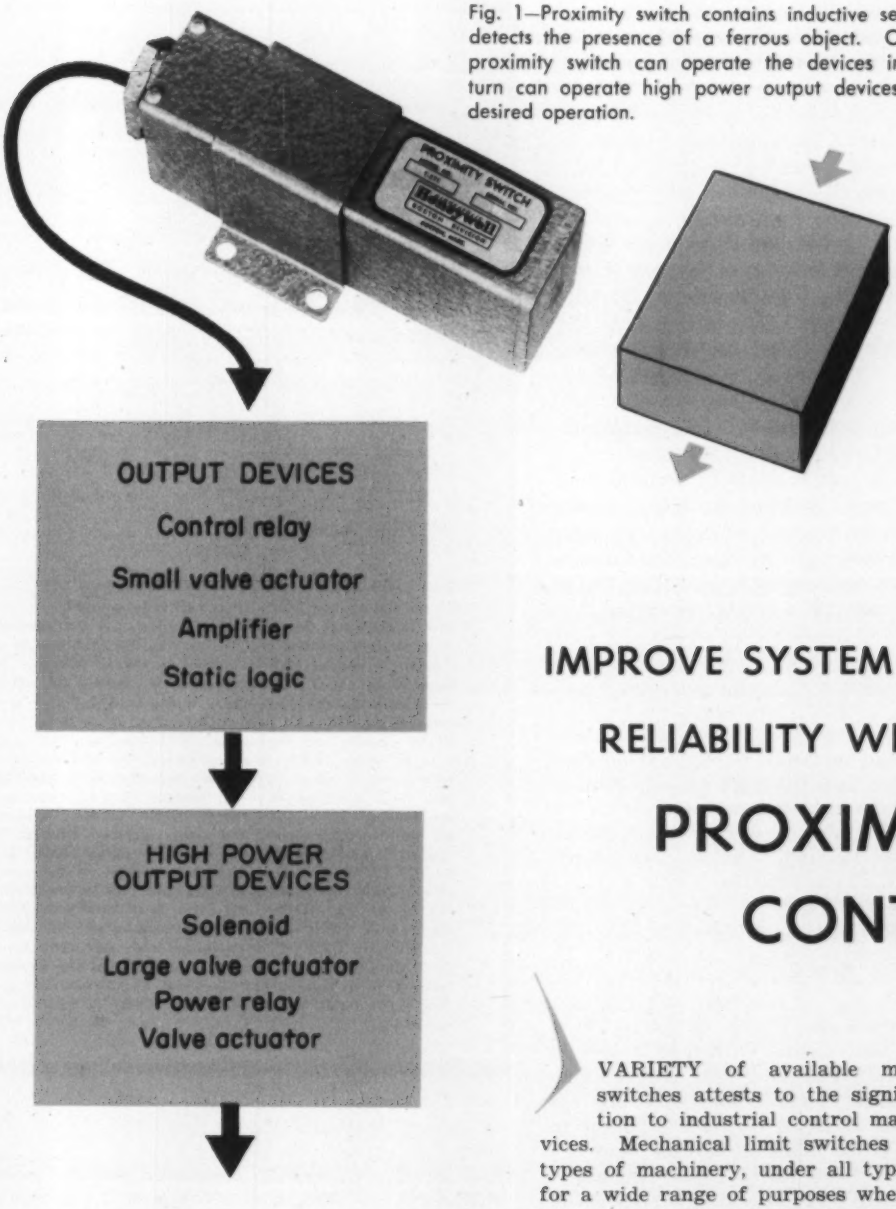

Fig. 1—Proximity switch contains inductive sensing head which detects the presence of a ferrous object. Output signal from proximity switch can operate the devices indicated which in turn can operate high power output devices to accomplish a desired operation.

IMPROVE SYSTEM RELIABILITY WITH PROXIMITY CONTROL

By D. T. LONGLAND
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Boston Div., Minneapolis-Honeywell Regulator Co.
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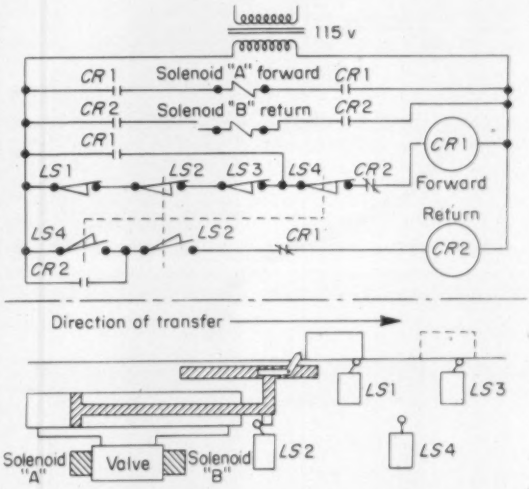
As operating experience uncovers weaknesses in control components, industry typically reacts by developing new or improved forms. Such is the background of the proximity switch—a recent development which augments the area of limit switch control.

VARIETY of available mechanical limit switches attests to the significant contribution to industrial control made by these devices. Mechanical limit switches are used in all types of machinery, under all types of conditions for a wide range of purposes where current must be switched. The variety of switch types not only indicates the basic need for such a device but also emphasizes the range of different characteristics required in applications.

In many applications extreme reliability of operation is necessary. For example, in railroad signaling operations it is rather apparent that limit switch failure without the proper protective safeguards can result in costly accidents and delays. In certain other applications the cycle of operation is at such a high speed that many millions of operations are built up in a very short period of time. Consider for instance, a grinder which is oscillated back and forth over a workpiece at 200 cycles per minute. This machine can build up approximately 100,000 cycles per eight-hour day and a million cycles in ten days time. In applications such as these—involving considerations of extreme relia-

Fig. 2—Comparison of two circuits, one with conventional mechanical limit switches, other with proximity switches. Both circuits accomplish same purpose in a typical transfer action.



Limit switches are indicated by the designation "LS" and relays by the designation "CR". If a part is in a position to be moved, LS-1 is operated thus closing its contact. If the transfer bar is in its starting position, LS-2 is closed in the CR-1 relay circuit and another section of LS-2 is opened in the CR-2 relay circuit. If there is an empty station in which to deposit the part, LS-3 is in its normally closed position. If the transfer bar is not in the forward position, LS-4 in the CR-1 relay circuit is in its normally closed position and the section of LS-4 in the CR-2 relay circuit is open. Thus CR-2 is de-energized and the CR-2 contact in series with the CR-1 relay coil is in its normally closed position; therefore CR-1 is energized. Two contacts of CR-1 close to operate the forward solenoid of the hydraulic transfer device to drive the part forward toward the empty station. Also at the same time, a contact of CR-1 seals the CR-1 coil in around LS-1, LS-2, and LS-3. When the transfer bar reaches its forward position LS-4 operates to de-energize CR-1 and LS-4 in the CR-2 coil circuit closes; LS-2 in the CR-2 circuit is in its closed position since the transfer bar is in the forward position and as CR-1 was just de-energized, CR-2 coil is energized and seals itself around LS-4. CR-2 contacts operate the return solenoid and the transfer bar is returned to its starting position where LS-2 is operated to indicate that the transfer bar is back and ready to take a new part forward.

bility or life—industry has had experiences which indicate that there are bounds to the use of mechanical limit switches. This is not to say that all limit switch failures are due to electrical and mechanical limitations. Other major influencing factors are misuse of a switch in ways which are not recommended by the switch manufacturer, use of a switch in bad environments, and maladjustment of the switch by untrained personnel.

The point to be made is that certain limit switches when properly used are capable of achieving exceedingly long life but when not properly operated (by not observing over-travel, load limitations, maintenance requirements, etc.) the life of a mechanical limit switch is greatly shortened.

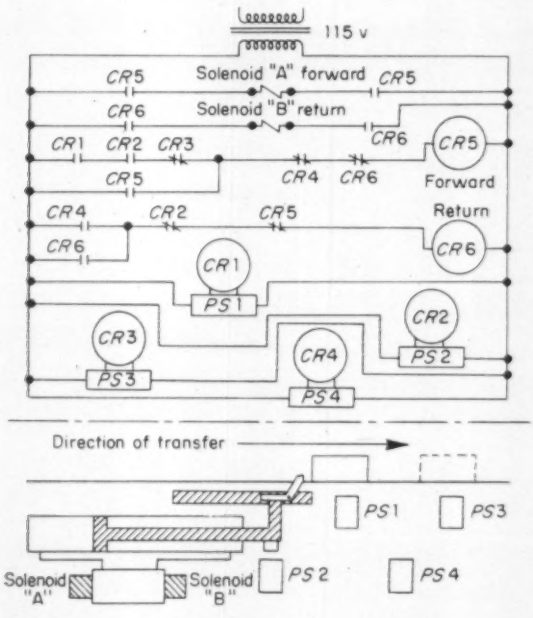
▸ Filling a Need

It is apparent that a device which can provide an electrical output without mechanical contact between the device and the part to be detected, and also without any electrical contacts within the device, might be desirable for certain applications. Such a device is the proximity switch. The following are desirable characteristics which a proximity switch should possess: (1) The unit should have ultra high reliability and unlimited life; (2) the unit should be as inexpensive as possible; (3) the unit should be as small as conventional mechanical limit switches, if possible; (4) the unit should operate from a line voltage of 100 to 126 v, 60 cps; (5) the unit should withstand a certain amount of vibration and it should not be damaged by oil, kerosene, or other lubricants; (6) the unit should not be actuated by parts adjacent to any surface except the working surface; and (7) the switch should have fairly rapid response—the time to operate a relay should be 0.1 second or less.

Today there are a number of proximity switches on the market. Some are designed to include vacuum tube circuits. These types generally provide that one of the vacuum tubes is used as an oscillator to supply excitation power to a pickup head. When a piece of metal is brought into proximity with the pickup head, eddy current loss is induced into the metal and this loss is reflected back into the oscillator circuit, thus upsetting the oscillator. An amplifier stage is used to amplify this change of state. This controls the current to a small control relay and thereby energizes and de-energizes this relay. It should be noted that the use of vacuum tubes in the device necessitates regular preventive maintenance in order to maintain continuity of production.

A different approach to the problem is exemplified by the Honeywell proximity switch, model T-271, *Fig.* 1. The device contains an inductive sensing head which detects the presence of a ferrous object. When such an object is in front of the poles of the proximity switch, there appears a signal output from a bridge which is fed through an appropriate magnetic amplifier. The magnetic amplifier develops an output of approximately one watt at its output terminals. This output is sufficient to drive any of a number of control devices. As indicated, one of these devices can be a 1 watt control relay. A low power hydraulic valve actuator which can be driven directly from a proximity switch or from a series of logic devices will shortly be available from Minneapolis-Honeywell.

The illustrated proximity switch contains no moving parts and no vacuum tubes. The device is completely embedded in plastic, hence it is not affected by coolants or lubricants. The magnetic amplifier and other components used in the switch circuits



Proximity switches are indicated by the designation "PS" and relays by the designation "CR". As shown, the outputs of the four proximity switches are individually connected to coils of the indicated relays. If a part is in position to be moved forward PS-1 and hence CR-1 are actuated. The transfer bar must be in its starting position as sensed by PS-2 which actuates CR-2. An empty station to which the part may be moved is indicated if PS-3 and CR-3 are not actuated. Under these conditions CR-5 is energized and seals itself in around CR-1, CR-2 and CR-3 contacts. CR-5 also energizes the forward solenoid of the hydraulic valve actuator, thus driving the transfer bar forward. When the part is moving into its new position the transfer bar actuates PS-4 and hence CR-4, dropping out CR-5; as CR-2 in the circuit has been de-energized, CR-6 is actuated. The latter seals itself in around CR-4 and also operates the return solenoid of the hydraulic valve, returning the transfer bar to its starting position. The transfer mechanism is now set up for another identical operation.

are the most reliable obtainable at this date. In this respect it is interesting to note that there are magnetic amplifiers currently operating which have been in use for 20 years or more and during that time have required no maintenance.

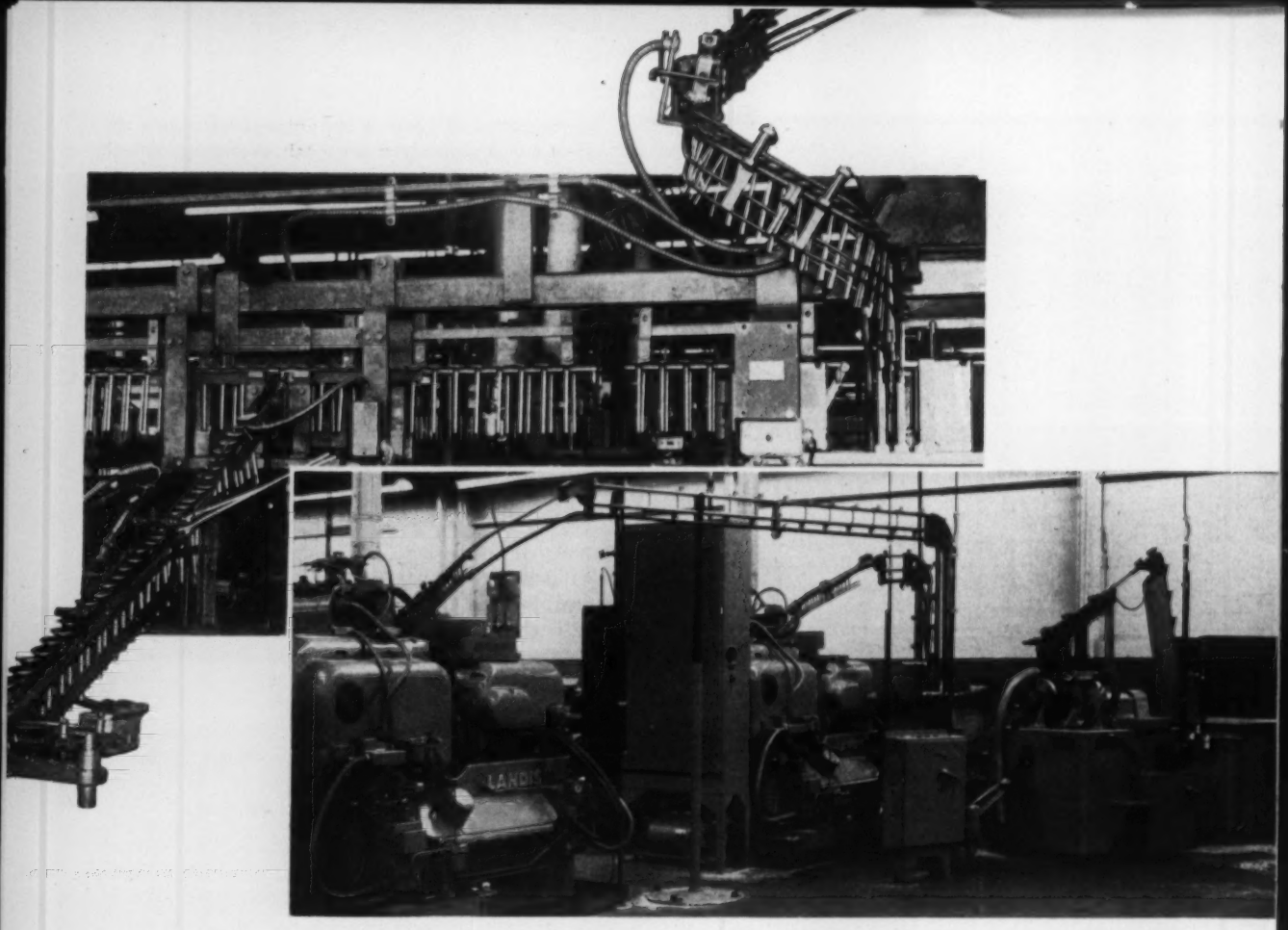
In general, proximity switches are somewhat more expensive in initial costs than conventional mechanical limit switches. However, this cost can easily be justified where the proximity switch requires no maintenance and does not contribute to downtime. In many cases where additional mechanical linkage is required in using mechanical limit switches, the initial cost of a proximity switch may not be greater than the total cost of a mechanical type together with its linkage.

The use of proximity switches can best be illustrated in comparison with a conventional circuit using mechanical limit switches. The example will be taken from the automobile industry where a large number of operations are built up in a relatively short period of time on an automobile engine line. It is not unusual for a switch operating on such a line to build up a million operations in less than a year. In engine plants, the environment is frequently very poor. There is a considerable quantity of abrasive dusts in the atmosphere and liquids used for lubricants and coolants are frequently in contact with the limit switches. These features all act to shorten limit switch life. A simplified typical automatic transfer line such as might be used for conveying engine blocks from one position to another is shown in the diagrams of *Fig.* 2. In the indicated operation it is desired that a block be moved from the starting position to a further station provided that certain conditions are met: (1) There should be a part present to be moved; (2) the transfer bar should be in its starting position; and (3) there should be an empty station in which to deposit the part. Under these conditions, a transfer bar will move forward, moving the part into its forward position. The transfer bar will return to its starting position if, during its motion forward, the bar actuates a switch device in the forward position. The proximity switch circuit in *Fig.* 2 illustrates the manner in which these devices are currently used in automatic transfer lines. In the future it is contemplated they will be used with static logic devices in a similar manner.

▶ Progress Continues

There are a number of other different proximity switches being developed for use in the future. Among these are high sensitivity units, two-package units containing a small sensing head with an amplifier package which may be located at a distance from the head, and proximity switches that operate not only on ferrous materials but any metal. Throughout the development program at Minneapolis-Honeywell the basic philosophy has prevailed that vacuum tubes cannot be used and to achieve reliability only magnetic circuits will be used if possible.

It is true that transistors offer some hope for high reliability circuits and their use is being considered for proximity switch applications. Developments are also aimed at overcoming another shortcoming of proximity switches. It may have been noticed that there is a fundamental difference between the proximity switch and a mechanical limit switch; the mechanical limit switch changes its state from a very high impedance to a very low impedance when it is actuated, whereas the proximity switches in general change their state from that of a low power output to a large power output when actuated. This implies that proximity switches cannot be connected in series, or that their contacts cannot be connected in series. Under development are a variety of proximity switches with an output that goes from a very high impedance state to a very low impedance state when actuated. These switches will be able to be connected in series and should prove more useful and versatile than previous varieties.



AUTOMATION FOR VALVES

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IT SHOULD BE recognized that to evaluate and design an automated process is not a straightforward analytical problem where one step absolutely follows the previous step to a finite answer. Many different and separate solutions may have to be worked out to determine the best one for the particular problem. However, through a series of calculations and refinements in limits, a workable approach may often be determined.

The example used in this paper of automating the finishing of exhaust valves is not the only answer to this problem, rather it is one approach believed to be best suited to the particular requirements of the Valve Division of Thompson Products, Inc.

Effective evaluation of applied manufacturing automation to the production of small parts may be accomplished by a systematic analysis of the following major items: (1) Potential savings and cost of automation, (2) process design, (3) machine equipment, and (4) material handling equipment.

Because the primary purpose of this paper is to discuss the mechanics of applied automation rather than the economic fundamentals, the "potential savings and cost of automation" section will include only the information necessary to give continuity to the primary discussion.

Potential Savings and Cost of Automation

The savings produced by an automated installation are generally brought about by a combination of reduced direct labor hours, reduced material cost, and reduced scrap loss. It is, therefore, reasonable to assume that a thorough analysis of

This article is based on a paper presented at the "First Conference on Manufacturing Automation" cosponsored by AUTOMATION and Purdue University, October 1956.

The application of manufacturing automation, for the parts supplier who does not control the design of the product, presents some rather complicated aspects of the automation problem and requires that added attention be given to flexibility of process, handling equipment and machine tools. Here are some primary factors to be considered relative to applying automation to small parts manufacture, using the finishing of internal combustion engine valves as one example.

these factors relative to the particular product would be performed. The detailed analysis used for this valve line example would be of little value when applied to an entirely different part, therefore, a general explanation of the procedure used is stated here rather than a detailed cost analysis.

The major savings that could be realized in this particular example were in direct labor and inspection labor for finishing the forging. The cost of automating the operation was balanced, primarily, against this potential direct labor saving. However, other areas of potential savings such as reduced in-process inventory and reduced floor space were also considered. *Fig.* 1, is a graph of the direct labor per unit of production plotted on the ordinate against the total investment on the abscissa. Note that the reduction in direct labor is not directly proportional to the investment and this proportion is less favorable as the degree of automation is increased. This curve roughly approximates the relationship as applied to the valve example and the curve would be somewhat different for another product analysis.

Assuming that the present degree of automation is at point *A* on the curve, the direct labor hours are 5½ and the investment is about one quarter-million dollars. Now if the direct labor is to be reduced by one half by further automation an expenditure of about $900,000.00 would be required.

Process Design

Determining the best manufacturing process for a given commodity is of primary importance and one of the more difficult problems to be solved. It is possible to select this best method only after exhaustive research, on the future possible product alterations, has been completed. Also, the parts manufacturer cannot wisely establish a method applicable to one item only. That is, a method that is ideal for one particular customer's part will not necessarily be the best for a different customer's part of the same general shape and design. To prevent the possibility of obsolescence of process, a thorough study of present requirements and an accurate analysis of future trends and demands is imperative. In the case of automotive exhaust

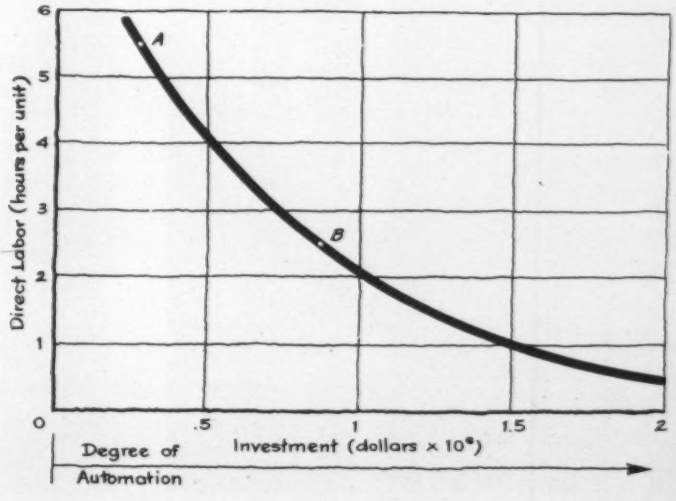


Fig. 1—Plot of direct labor vs. capital investment shows comparison between manual process, *A*, and automated process, *B*, for valve production.

valves, this analysis had to answer such questions as:

1. Will the valve remain a one-piece valve design or will the welding of a head and stem material be necessary?
2. Will the materials used in the next five to six years be forgeable, as they are today?
3. Will a cast valve be required?
4. Will the material be machineable?
5. What heat treatment is likely to be required?
6. Will the overall physical dimensions change radically i.e., head diameter, length of stem, stem diameter?
7. What tolerance and finishes will be required?
8. What type of retainer grooves will be used?
9. Will the stem have a carbon relief?
10. What identification markings are likely?

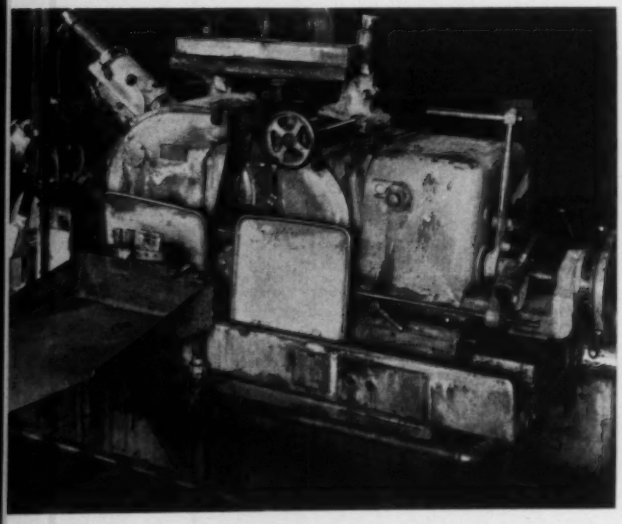
When suitable answers are found to these and many other important questions, then, and only then, can the manufacturing process to be automated be determined. In the case of the exhaust valve this information was resolved to a fundamental method applicable to the foreseeable future needs. *Fig.* 2 shows the basic differences between our present method of making a valve and the automated process. Note that the present method consists of forging, rough machining, heat treat, and finish grinding while the new automated method eliminates machining and includes forge, heat treat and finish grind operations.

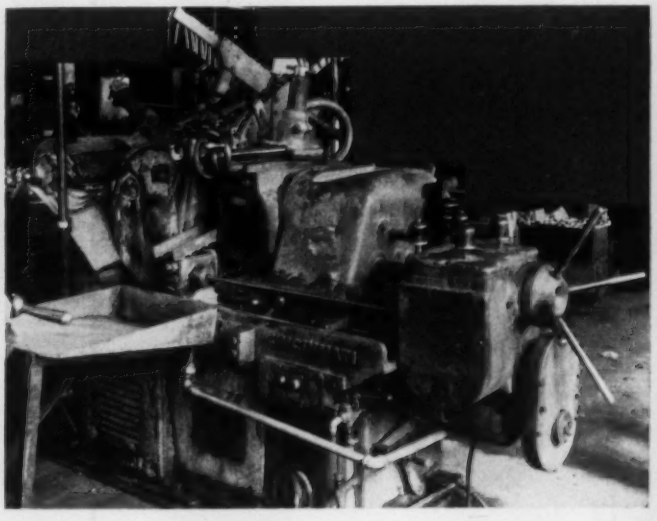
An example of necessary compromise can be seen in the omission of machining operations in the automated method. The disadvantage of this is that the grinding operations to remove the semifinish stock will be more expensive. However, this disadvantage is outweighed by the less obvious advantages such as: (1) The flow of work need not be interrupted for a batch heat-treat operation, (2) the possibility of a nonmachineable material obsoleting the method is eliminated, and (3) a grinding wheel can be made to run for several shifts without downtime for tool adjustment and changes, thus allowing continuous operation for extended periods.

The selection of the manufacturing process to be used will naturally be dependent on the particular part or parts to be manufactured and no universally applicable method of selection can be applied. However, certain restricting factors have to be recognized when attempting to reduce the manufacturing cost by automation. The product mix, the lot sizes involved, and the future possible product design changes must be considered and the process must be flexible enough to accept these conditions. Some degree of compromise from the ultimate in productivity may be necessary to prevent premature obsolescence of process and equipment.

An example of this type of compromise is found in the selection of the groove and tip chamfer grinding process. This operation can be performed at 1200 pieces per hour (approximately) on a machine that is restricted to certain groove forms that can be diamond dressed. The possibility of having to grind a groove form that cannot be diamond dressed, because of contour, dictated the use

Series of photographs records the evolution (left to right) of automated grinding equipment to finish valve stems. Workpieces were manually fed to original machine with wheel dressing and advance manually controlled in accordance with hand inspection of finished part. The machine developed for inclusion in an automatic line incorporates automatic loading and unloading, automatic dress of wheel, automatic wheel adjustment to compensate for dress, and automatic adjustment for size as indicated by feedback signals from post-process gages.





of crush dressing. Although the production capacity of this crush-dressed operation is about 700 pieces per hour per machine, the acceptance of this lower output operation is less detrimental than the acceptance of a process that may be obsolete two years hence.

The selection of the optimum productive capacity of the small parts automated installation is dependent on several factors such as: fluctuating customer requirements, the matching of individual machine production rates, the lot sizes required of any one design part, and the potential future increase of customer's requirements.

In the course of one year any one automotive engine builder's requirements may fluctuate as much as 100 per cent. This requires a production capacity flexibility not normally encountered in some fully automated projects and in this case it is necessary to be able to supplement the production requirements during the off periods by the introduction of a different part into the line.

To cope with this fluctuating requirement, the line has been sized to handle the average monthly requirement on a 2-shift, 5-day week, basis. By using part of the 3rd shift and weekends the productive capacity may be doubled to meet the seasonal peak demands.

The selection of the ideal line capacity cannot be made on the basis of production requirements only and, unless these production requirements fairly closely match the productivity of the selected machine tools, an uneconomical operation may result. Therefore, the production requirements and the productive capacity of the machine tools have to be balanced and evaluated as a combined unit. It is not always possible to obtain standard machine tools that exactly match the production requirements, particularly when multiples of one design machine tool are required on one operation to match the output of a single machine tool on a faster operation. In this case, it may be advisable to operate some machine tools at less than the maximum productivity to be able to effect a combination of machines that will yield the best manpower productivity.

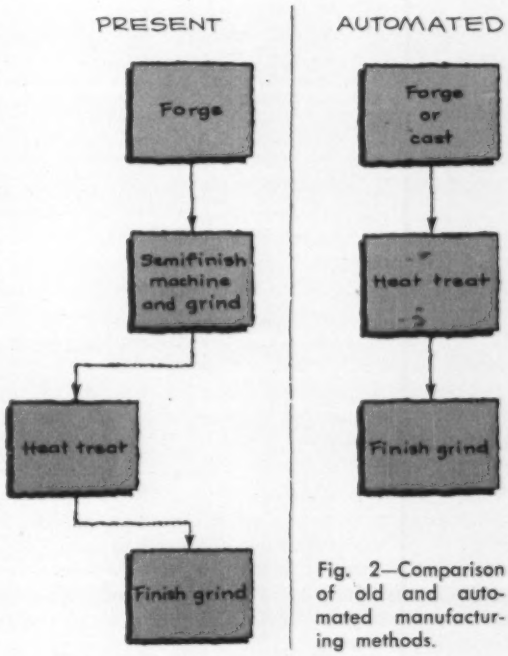
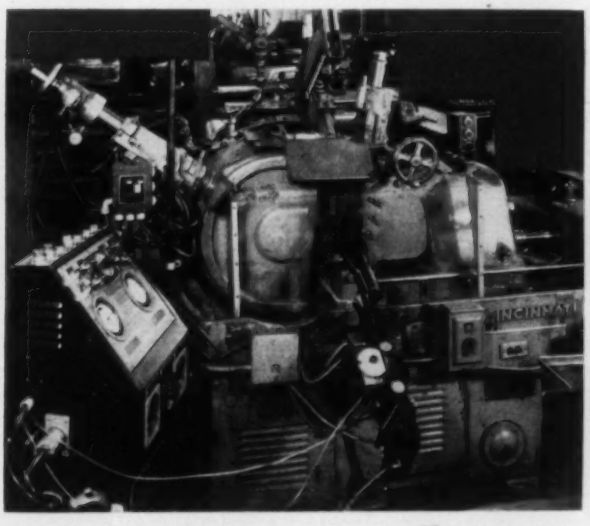
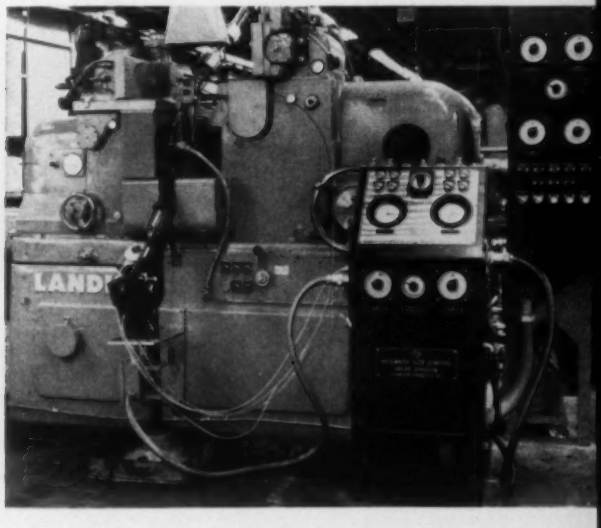


Fig. 2—Comparison of old and automated manufacturing methods.





For example, in the installation of this valve line, three grinders, each having a capacity of 800 pieces per hour, are matched to a tip grinder that has a productive capacity of approximately 3000 an hour.

Machine Equipment

When the manufacturing process has been defined and practical limits on production requirements of each operation have been established, the problem of the selection of the machine tools may be approached with a clear understanding of the requirements. Whether standard, semistandard or special design machines are used depends on the availability, degree of flexibility required, and the degree of automation desired. In many cases it may be possible to obtain standard machine tools of proved design equipped with satisfactory loading and unloading devices that are directly applicable to the particular operation and product under consideration. However, it may not always be possible to obtain the degree of automatic control desired in a standard machine tool and modification of standard machine design may be necessary, thus producing a semistandard machine with suitable compensation and size control features. In view of the flexibility requirements of the parts manufacturer, the use of flexible standard machine tools is in many ways better than the use of special design single-purpose maximum productivity machine tools.

The equipment for performing the grinding operations on valves has been developed over the past several years and these special machines, which are in reality modifications of standard machines, are in most cases readily available. The four basic types of grinders used in this installation are: (1) Centerless grinders, (2) disk grinders, (3) collet chuck type center grinders, and (4) centerless crush dressed grinders.

The diamond-dressed centerless grinders are used on the stem grinds and are entirely automatic in operation by virtue of the following features: automatic loading and unloading, automatic dress, size compensation after the dress, and size compensation by feedback signals from post-process gages. These features make continuous unattended operation possible and operator attention should be required only to make periodic manual adjustments for stem taper should this condition arise. In these operations every part is gaged insuring that the part being fed to the next operation is size controlled.

The disk grinders used for grinding the top head and tip are basically standard disk grinders modified for valve grinding. Automatic loading and unloading as well as built-in size control and compensation features will permit these machines to run unattended for extended periods and produce size-controlled parts.

The collet chucking center grinders are standard valve face grinding machines which collet the stem and grind the face to very close concentricity tolerances. These are also equipped with automatic loaders and unloaders, automatic dress and size compensation after the dress. Here post-process gaging is employed to inspect the final operation and sort parts for concentricity. Feeding back a corrective signal for concentricity is impossible and should this out-of-tolerance condition arise the machine must be shut down and manually corrected. The post-process gage is used here only to insure that good parts are shipped and to stop the machine and signal the operator when the process goes out of control.

The centerless crush-dressed groove-grinding operation and the crush-dressed roughing operation on the head OD, seat and corner break brought about an entirely new machine design and the only completely special machine in this line. As was pointed out earlier, the need for maintaining flexibility of process required that these crush-dressed grinders be used. Automatic loading and unloading as well as post-process gaging with feedback are also included.

Material Handling Equipment

The selection and design of the material handling equipment, for a high-volume small parts automated line, is an intriguing problem and several different methods have been used successfully in various industries. This type of manufacture is

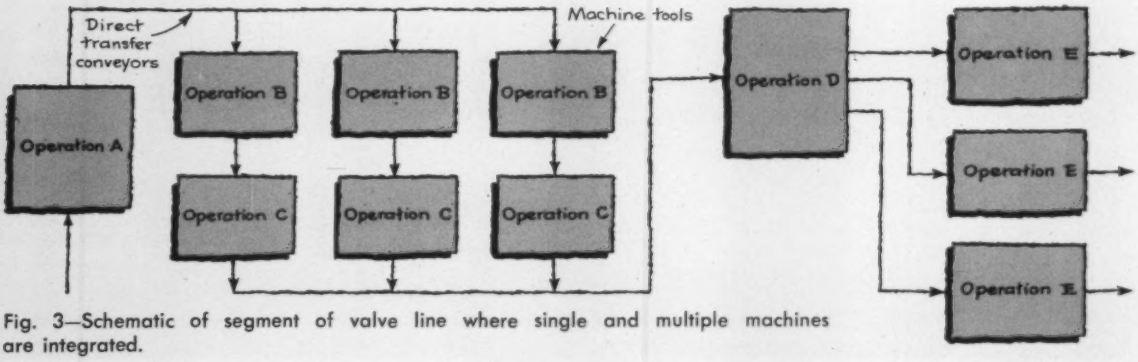


Fig. 3—Schematic of segment of valve line where single and multiple machines are integrated.

Fig. 4—Photograph of valve conveyor used to handle, feed and store valves in transit.

probably best performed on the so-called unitized line where separate machines are used for different operations with storage of parts provided between machines. Here the major considerations are: (1) How much float or storage is advisable? and (2) What type storage, bulk or oriented, should be provided? The answers to both of these questions depends entirely on the particular part being processed, the manufacturing method chosen, and the necessary idle time of the machine tools. (necessary idle time is here defined as time lost for tool changes and wheel dressing.)

In *Fig.* 3 is shown schematically one machine arrangement of a segment of the line where multiples of a machine type must be integrated to one machine of a type. The problem here is to provide a material handling system that will adequately feed the machines. In the selection of a suitable material handling system for this installation, several avenues were explored as follows:

1. The use of large-quantity bulk storage hoppers between operations would provide the best margin of safety. However, feeding valves from hoppers is impractical because of the geometry of a valve; and damage to finished surfaces would result. It was therefore, decided that the valves should be oriented once and that this orientation would be maintained throughout the line.

2. The use of large-quantity oriented storage between operations is desirable and an extensive storage conveyor system is necessary. In view of the flexibility required in this particular installation where a change in shape of the valve might obsolete an extensive storage conveyor system, or make expensive rework necessary, this type of storage was deemed inadequate.

3. Direct transfer by conveyor from one machine to the next with sufficient storage to take care of the "necessary idle time" would provide the greatest degree of flexibility and still maintain orientation of the part. This type system required a simple, flexible conveyor system with sufficient storage to allow for wheel dressing. Also, interlocked controls were necessary so that the feed to a particular machine that is interrupted for wheel dressing would not cause congestion in the conveyor and chutes of the preceding machine.

The third system described was the one chosen for this valve installation and a suitable transfer conveyor system was designed. *Fig.* 4 is a photograph of the type of conveyor used to transfer the parts from the outlet chute of a post-process gage to the inlet feed chute of the next machine. This new design conveyor will lift the parts vertically to a height sufficient to feed the next machine chute, then make a right angle bend and extend horizontally to feed them into the loading chute. As may be seen in *Fig.* 5, the valve is carried on two support lifters which are pushed along slotted tubes. The force to move the lifters is provided

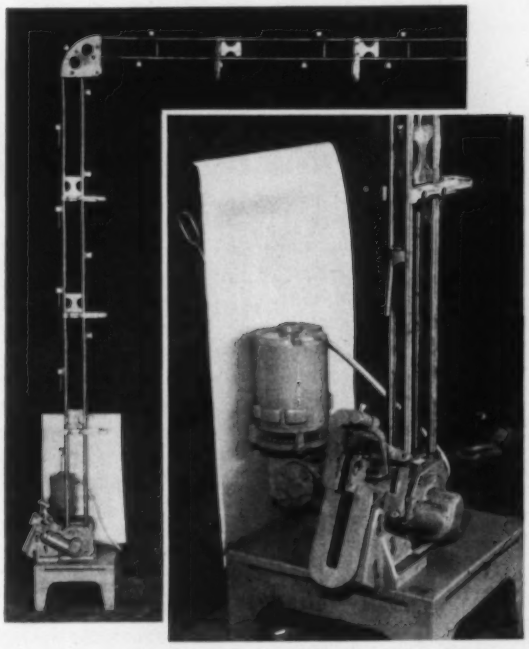


Fig. 5—Photograph of valve conveyor (partial view) showing valve handling device which is pushed along slotted tubes by balls. Motorized pump circulates balls through tubes. Valves feed by gravity into slotted access in foreground.

by bearing balls which are pumped through the tubes. This chainless conveyor, which was designed and patented by Thompson Products, permits transfer in any desired direction.

Certain specific rules of operation are being applied to make this line function as a complete unit. That is, all "maintenance to setup" work such as wheel changes, diamond changes, and permanent tooling replacement will be performed on the "off" shift. Scheduling all of this major tooling maintenance work into a definite period provides the advantage of possible continuous line operation for from 16 to 20 hours. However, the maximum daily utilization of the equipment is restricted to 24 hours, less the planned downtime hours.

At the present time the exact number of hours required in the "down" period is indeterminate because the line installation is not fully complete. The tooling expense is expected to be slightly higher due to wheels being changed prior to the normal depletion time; that is, it is expected that a wheel that is worn to the point where it will not last another 16 hours will be replaced on the 3rd shift.

This is but one of many solutions to the problem of applying manufacturing automation to small parts manufacture and it should be remembered that any one company's individual requirements and past experiences relative to material handling are the primary influencing factors in the selection of an automation system.

AUTOMATING A SMALL-LOT SHOP

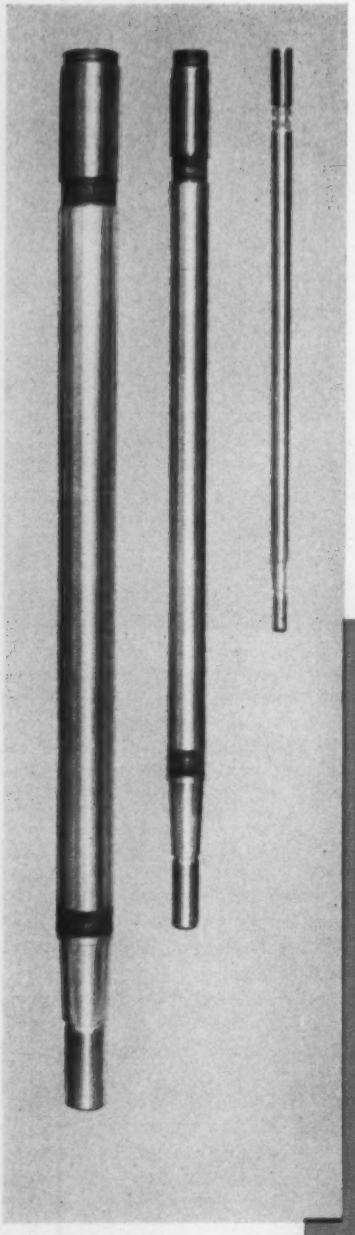


Fig. 1—Piston rods for mud pumps used in the oil fields are supplied in several hundred model variations. Sizes range from one-inch diameter by two feet long to four-inch diameter by over five feet long. Average order is for 20 to 30 pieces.

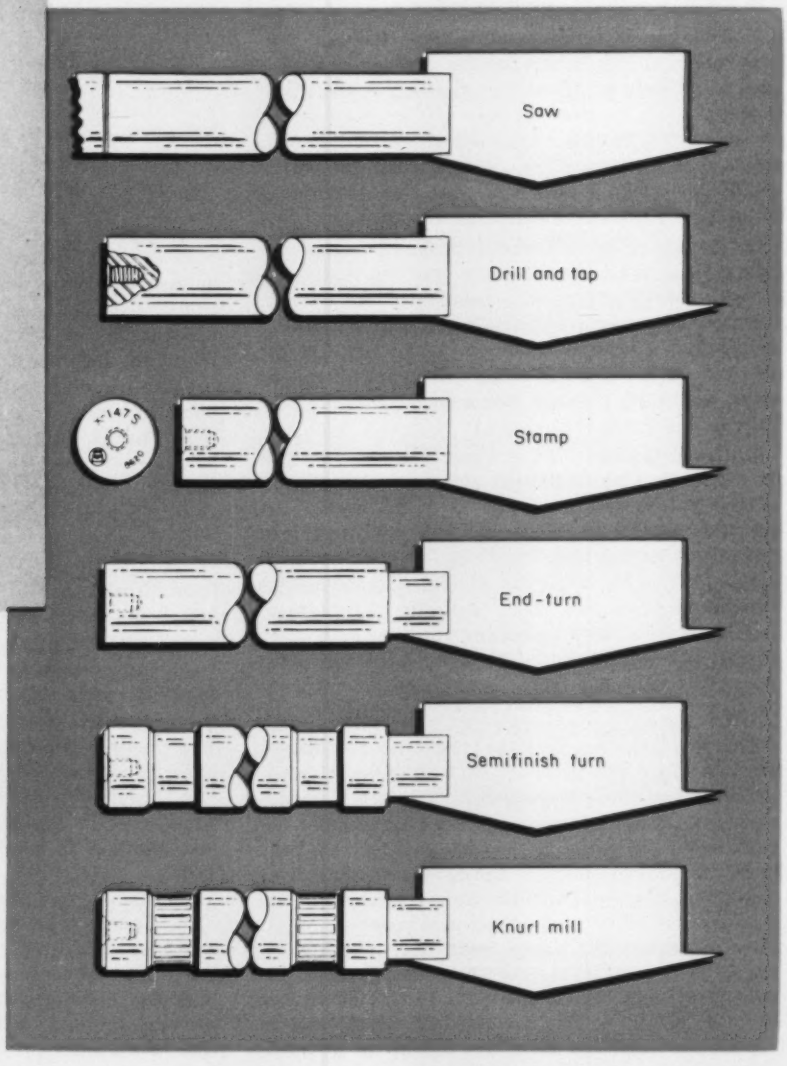


Fig. 2—The first six steps in the production of mud pump piston rods from bar stock are indicated by these sketches. Six units to perform these functions are to be integrated into a single automated line.

ONE OF THE AREAS in which automation holds high promise of rewards is in its application to small-lot production operations. Flexible techniques and equipment to automatically perform operations for producing limited quantities of identical parts can be applied to advantage by small as well as large plants; the problem lies in "putting the words into action". Mission Mfg. Co., a supplier of oil field equipment, not only believes the advantages of automating small-lot production are worthwhile, but they have a plan to do so and are investing in the equipment to implement the plan.

They have a partially completed automatic production line which will change bar stock into semi-finished piston rods for mud pumps, *Fig.* 1. The parts to be produced include about 600 models ranging from one-inch diameter by two feet long to four-inch diameter by more than five feet long. Although production is several thousand rods a month, very few orders call for as many as 100 identical rods; the average order is for 20 to 30 pieces; but many orders for one or two pieces are filled.

The Plan

Operations to be performed on six integrated units in an automatic line are illustrated in *Fig.* 2. The operations include the first six steps in production of the piston rods: sawing, tapping and centering, stamping, end-turning, semifinish turning, and knurl milling. At this time, automation is not planned for subsequent operations.

Cards punched for the dimensions and quantities of parts required will be fed into a card reader of a master console which controls actions of all six units in the line. Signals from the master console will cover lengths, positions, diameters, tap sizes and other needed specifications. Initial operation will use an individual card reader for each unit, *Fig.* 3, and a cascaded diode-and-resistor bridged circuit will be used in the temporary operation. The final method to be built into the completely integrated line has not been determined, but several methods are under investigation, including the use of a slide-wire having a null point established by data on the punched card. A contact can be attached to the carriage or slide to be positioned so that it will feed back its electrical position. Another system under consideration is a modification of the coaxial bifilar coil setup described by Canadian Westinghouse.

Signal lights will inform the machine attendant what diameter bar stock to feed into the saw. Bars of improper diameter or insufficient length will be refused by the saw. The saw feeding mechanism will adjust to proper length and the part will be cut off. Pushers will raise the blank to a gravity-feed rack which drops it into the drilling and tapping unit. Signals from the master console will call for one of two tap sizes, either ½-13 or 5/16-18, and this unit will drill the correct hole and tap it. Another gravity rack will drop the part into the stamping machine which stamps identification marks on the end of the rod. Up to 12 characters will be stamped around the tapped hole in accordance with instructions from the punched card. These characters may be any of the letters of the alphabet, the ten digits, punctuation marks, and a few symbols such as the Mission trademark and the API symbol.

The part will then be lifted to a wait-rack from which it will be picked up by an overhead transfer

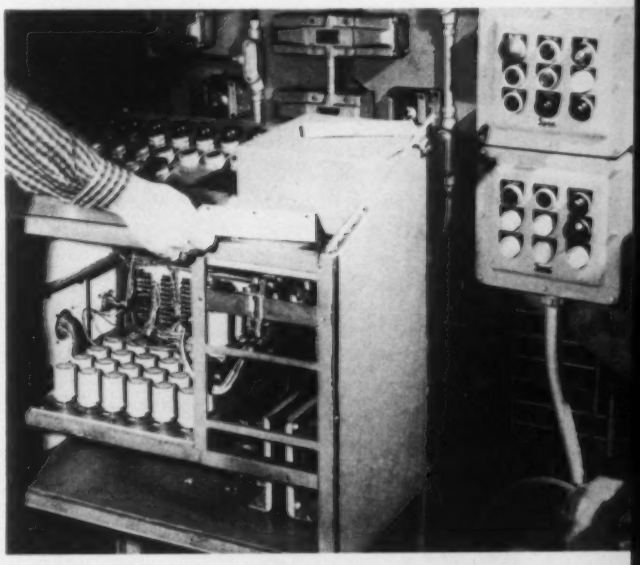


Fig. 3—This preliminary control arrangement was developed to provide a separate card reading control for each machine unit. Individual units can thus be installed and operated one at a time until the complete installation is ready.

mechanism and inserted into a modified turret lathe for end-turning. The transfer mechanism consists of a box frame which is equipped with two lift arms with grab claws. One arm will lift the part off the wait-rack and insert it into the end-turning lathe while the other arm removes the previous part from that lathe and inserts it into the lathe to semifinish turn the body of the rod. The end-turning lathe will turn a short chucking length of about 2½ inches and the body turning lathe will turn the rest of the rod, including end chamfer and undercuts for knurls.

After completion of turning, the part will be carried to the knurl milling machine, *Fig.* 4, which

might more accurately be called a spline cutter. This machine will mill wrench slots on the undercut diameters. It will unload itself to a powered roll-conveyor carrying the rod to a wait-table, ready for further operations.

Implementing the Plan

Engineering of the system is being done by the people at Mission. They have already built the knurl mill, and a No. 3 Warner & Swasey has been rebuilt with a Reliance VS drive for the end-turning operation. A Monarch lathe for the semifinish turning is also well along, with tracer control built by Mission for beginning operations and the card control to be added later. The sawing, tapping and stamping units will not be built and installed by Mission until late in 1957. When these units are installed the individual card readers will be replaced by a master console which will control the operation of the entire line.

An interesting feature in the end-turning lathe is the method of holding the workpiece. The tail turret is used as a pusher to feed all but three inches of the workpiece into and through the chuck. The end of the rod pushed through the chuck is held in the cone-shaped face of a free-floating piston which moves in a tube back of the spindle. Air pressure pushes the piston against the end of the rod and so supports it during cutting. The piston also pushes the part back out of the spindle and ejects it when the chuck jaws are opened and the tail turret retracts. Another interesting feature is the use of a Square D proximity switch to position the chuck for automatic "stabbing" with the torque wrench.

Expected Benefits

Though it would be difficult to list the benefits in the order of their importance, they might be summed up to say the aim is to achieve substantial savings through the use of automatic machine setup as well as automatic handling and transfer. Specifically these goals include:

1. A reduction in setup time of approximately 90 per cent.
2. Faster cycles and resultant overall increase in production capacity of approximately 50 per cent.
3. An ultimate reduction in direct labor per piece of approximately 65 per cent.
4. Shorter process time.
5. Decreased amounts of material in process.
6. Decreased spoilage.
7. Decreased tool and tool setting costs by use of simple single-point tools.
8. Better design of knurl used on the product.
9. Increased knowledge for future tooling needs.

Since business at Mission is based on being able to produce economically and rapidly in small lots, management feels use of methods such as outlined here is one good way to improve company products and customer service, and at the same time improve the status of the company's employees.

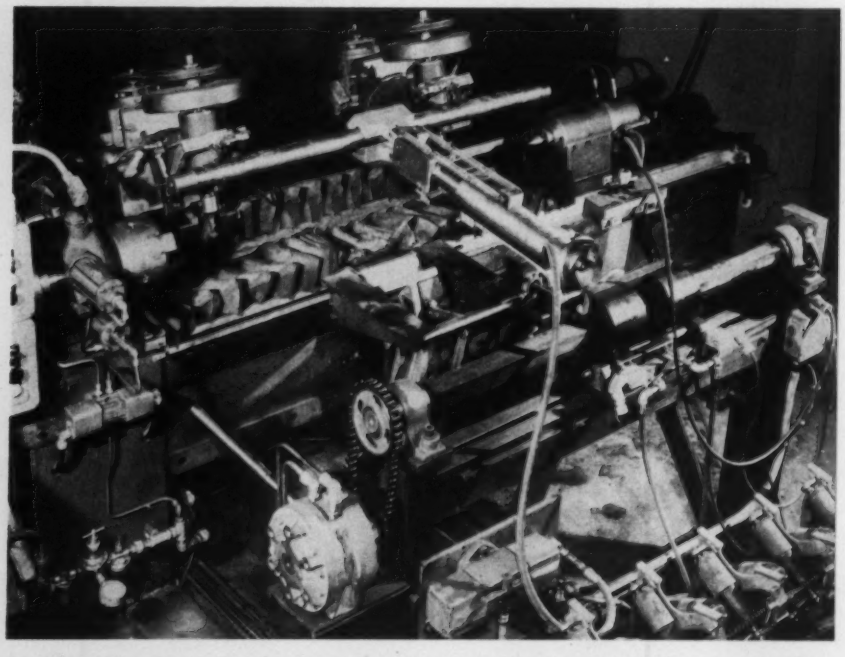


Fig. 4—This unit machines knurl sections on each end of the rod. Loading, unloading, and cutting operations are automatically controlled by punched cards.

TRANSFER MACHINES FORM
SECTIONAL LINE

TRACTOR DIFFERENTIAL center housings, *Fig.* 2, are now being completely machined at the rate of 46 per hour on a sectionized line of three Transfer-matics and two precision boring machines developed by the Cross Co.

The line, *Fig.* 1, which is 32 feet wide and 225 feet long, consists of 31 stations divided into four sections—the first section machines the top and the bottom of the housings; the second, the two sides; the third, the ends; and the fourth precision finishes the important bores.

Section 1 is a nine-station, pallet-type transfer machine. Rough castings are clamped in pallet work holding fixtures and are not released until the top and the bottom faces are finished and the locating and transfer points for succeeding sections are processed.

Operations performed in Section 1 are milling, drilling and tapping of the hydraulic lift cover face; straddle milling, drilling and reaming of the hydraulic rocker arm pin hole; drilling and reaming two locating holes in the bottom face; drilling and

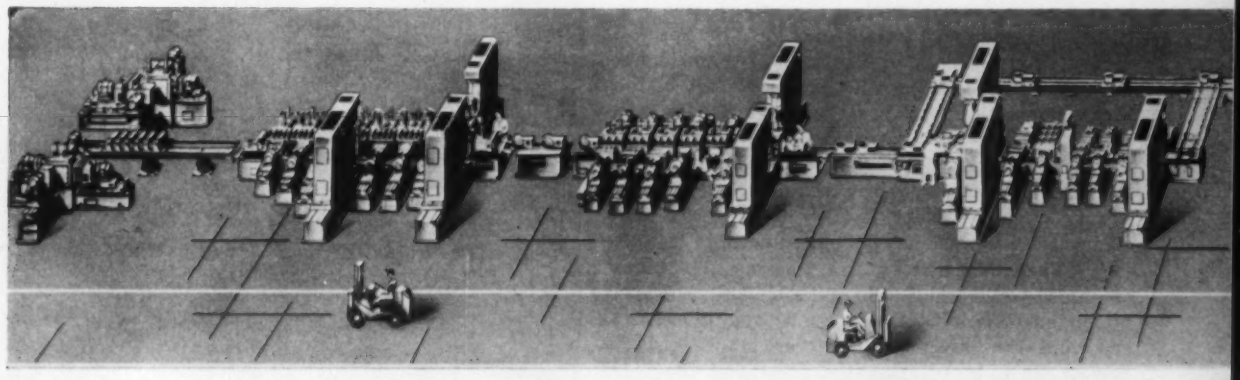
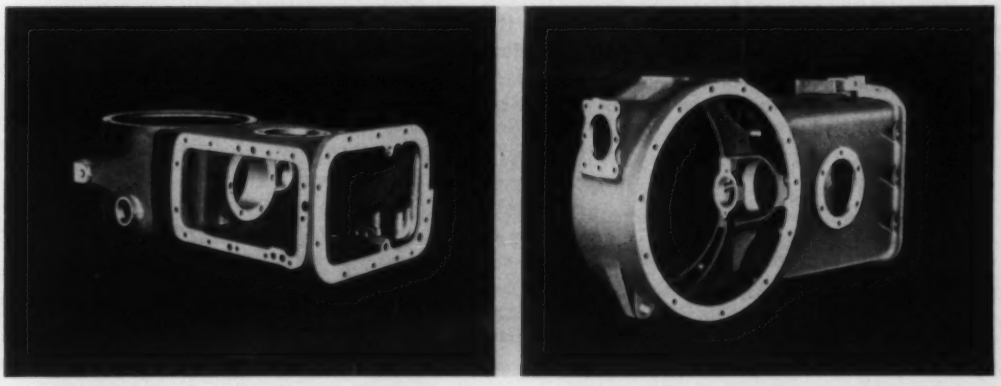


Fig. 1—Production line for machining tractor differential housings has pallet-type transfer machine at right, two straight-through transfer machines in center and two precision boring machines at left. Transfer machines handle all workpieces in series. Parts go to either boring machine.

Fig. 2—Two views of tractor differential housing machined on production line that consists of three transfer machines and two precision boring machines.



reaming two target locating holes in the top face; and miscellaneous milling, drilling and tapping operations on top and bottom.

Section 2 has nine stations and performs all of the operations on the sides of the housings. Pads are milled, two axle housing pilot bores are bored and cross-faced; ring gear clearances are milled; and all holes are drilled, chamfered and tapped.

Section 3 is another nine-station group of units which performs the operations on the front and rear of the parts. As they progress from station to station, both ends are rough and finish milled, the bevel pinion shaft hole is rough and semifinish bored and faced; the intermediate power takeoff shaft hole is rough and semifinish bored from both ends and faced, and holes are drilled, chamfered and tapped.

A unique feature of the installation is the simple way the parts are transferred, located and clamped in Sections 2 and 3. Transfer bars lift the part from one station and carry it to the next where it is lowered over two locating pins fixed to the base of the machine. The top face of the part has target center holes which were machined in Section 1. In Sections 2 and 3 these holes are engaged by two centers in an overhead bridge to hold the part securely in each work position.

In Section 4, two identical four-way boring machines equipped with single point tools perform all of the final finishing operations. Two machines are required to keep up with the production of the preceding sections because the feed rates for the finishing operations are much finer than they are for the rough and semifinishing operation.

In the finishing machines, the part is located in the two reamed holes in the bottom face and clamped through the target center holes in the top face. Then the two rear axle housing pilot bores are finish-bored and faced from the sides, the bevel pinion shaft hole is finish-bored from the front end, and the intermediate power take-off shaft hole is finish-bored from the front and the rear ends. By finishing all of these bores in the same position, indexing errors are eliminated and gear centers are maintained in good relationship.

Total operations performed are 313 including 19 milling, 7 cross-facing, 110 drilling, 17 boring, 72 chamfering, 4 spotfacing, 8 reaming and 76 tapping.

This installation illustrates a progressive modular approach to an integrated production facility to machine a particular workpiece. Machine units are put together to form work stations—these in turn make up the sections and the sections comprise the production line. Often referred to as the building block technique, this scheme is being applied to the arrangement of automatic cycling machinery in many automation programs.

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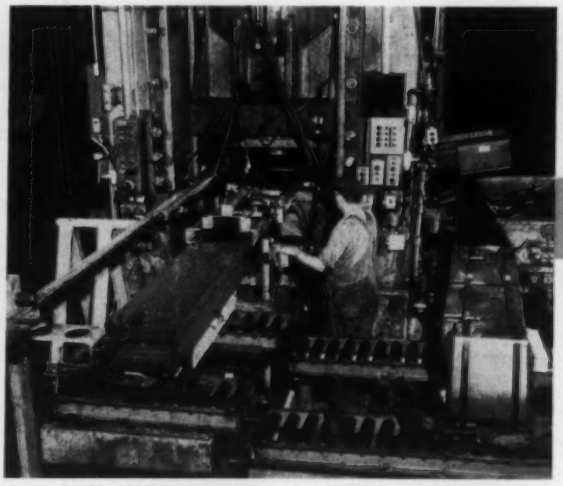


Fig. 1—Start of the automated press line that produces Buick Dynaflow primary pump covers from heavy strip stock fed automatically from a stack. One man is needed to watch performance. He can stop the line instantly when necessary.

THREE

By HERBERT CHASE
Mechanical Engineer
Forest Hills, N. Y.

PUMP COVERS for Dynaflow automatic transmissions are among stampings made in an automated setup of three presses in a sheet metal plant of Buick Motors Div., Flint, Mich. These are circular stampings produced from strip stock 0.245 inch thick and require heavy presses, even though the forming required is shallow.

At the start of the press line, *Fig.* 1, strips long enough for four covers are stacked so as to be fed automatically by an air plunger synchronized with a first Cleveland press that blanks out the parts and pierces a central hole in them. Strips are advanced first into a channel frame from which a second air plunger moves the strip into the die, far enough to produce one blank at each working stroke.

Excess stock is chopped off at the end of the die and falls through a chute to a short belt conveyor that delivers the offal to a scrap box. The slug pierced from the hole is similarly handled. Blanks fall into a discharge chute and are elevated to an

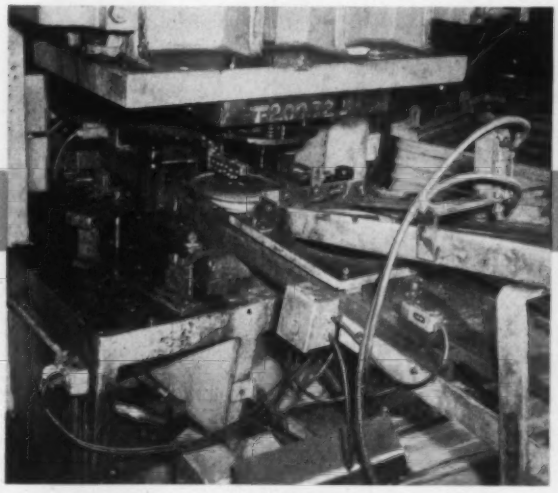


Fig. 2—Setup at the third press showing the loading chute with its hydraulically operated gate that prevents feeding of more than one part at a time. A finished stamping is about to be taken from the die by an unloading arm and finger.

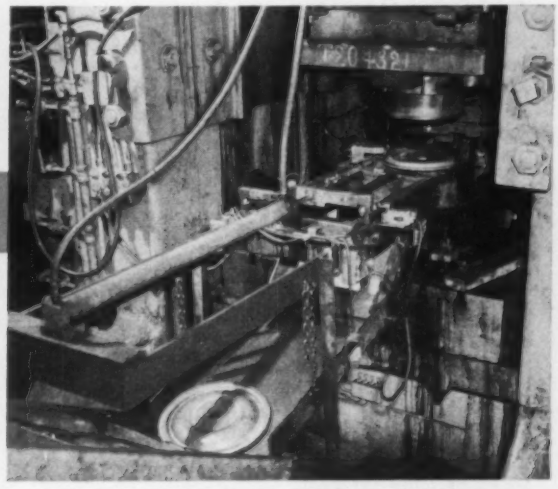


Fig. 3—Discharge side of the third press, showing a workpiece ready to be struck. After the die opens, the stamping is drawn out by an automatic unloader and falls into a discharge chute that delivers the parts to an elevating conveyor.

PRESSES WORK TOGETHER

inclined chute that feeds the blanks to a second Cleveland press of 1500-ton capacity. Feeding is similar to that in *Fig.* 2.

Blanks reaching the lower end of this feed chute drop one at a time through a hole and onto a slide arranged to feed each blank to the die in which forming is done. This slide is air operated and, of course, its motions are synchronized with the press, so that the loading occurs with the die fully open and the ram at rest.

At the die, there are two buttons that are pressed automatically by the blank when it reaches the position that will insure correct forming. These buttons cycle the press. Closing of the die produces a central boss and a crowned area between it and the flat flange, which is outside the formed area.

After the die opens and before the next blank feeds in, an air operated arm moves in automatically from the back of the press and a finger on the arm engages the hole in the stamping. Withdrawal of the arm, following immediately, causes the stamping to be pulled out of the die and to slide down a chute to a belt for elevation to loading slide of the next press. Thereupon, the die just unloaded is reloaded ready to repeat its cycle.

Forming of the flange and repiercing of the hole are done in the third press, a 125-ton Cleveland. Loading, *Fig.* 2, is similar to that in the prior press, where the piece drops through a hole at the lower end of the chute and, when it reaches correct die location, actuates limit switches that cycle the press. A hydraulic gate is arranged to prevent feeding more than one piece per cycle. *Fig.* 3 shows the back of this press with a piece in the die ready to be struck and a completed stamping at the bottom of the discharge chute into which the stamping drops when taken out of the die by the arm shown in *Fig.* 2.

Pierced slugs are pushed through the die and fall into a chute leading to a scrap box. Completed stampings from the discharge chute drop onto an elevating belt that deposits them in a tote box.

With the combination of automatic feeding and actuating devices described and the unloaders, chutes and elevating belts mentioned, automation is substantially complete and one man, stationed at the start of the line, easily keeps track of the whole setup. This operator, of course, can start and stop the line at will. He also supervises the placing of new stacks of strips when needed.

AUTOMATED MANUFACTURE OF ELECTRONIC ITEMS

By HOWARD S. GLEASON
Manager of Automation
Stromberg-Carlson Co.
Rochester, N.Y.

JUST AS other manufacturers are doing, manufacturers of electronic equipment are continuously looking for improved products, improved product designs and improved processes to manufacture their products. The Stromberg-Carlson Co. has been responsible for many developments in these areas, one of which is depicted in *Fig.* 1.

The arrangement shown is designed for the use of printed wiring boards and standard electrical components in manufacture of electronic packages that will fulfill the requirements of many commercial and military items. This system has the capacity to produce as many as 1200 units per hour with the flexibility to run relatively small lot sizes. It produces the printed wiring boards, makes the component assembly, solders and cleans the units. A future addition will completely inspect the finished product.

This integrated system utilizes to the fullest extent the standards that have been developed by industry, and many machines that have proved themselves in service. An example is the standard in-line component assembly equipment. There are at least 14 installations of this type of equipment operating in the United States and they represent a tremendous production potential.

Comparison of the productivity of the automatic manufacturing system with alternate methods gives a graph like *Fig.* 2. It can be seen that direct labor costs are much less per unit. Also, conventional hand assembly requires roughly three times the floor space required for in-line assembly equipment if production rates are equal and acceptable.

With this example in mind, it seems that we can expect the following from most types of mechanized manufacturing:

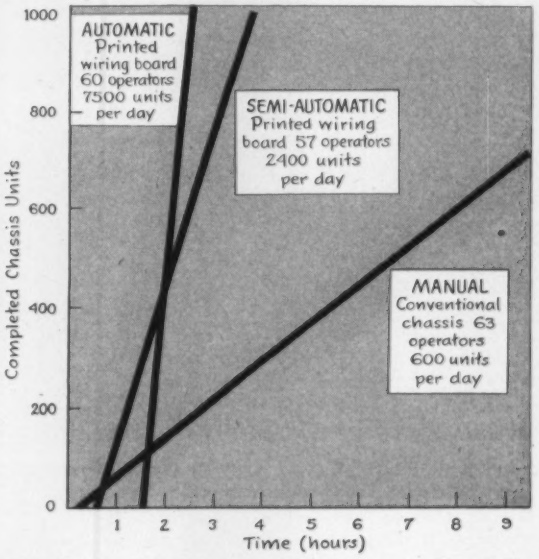
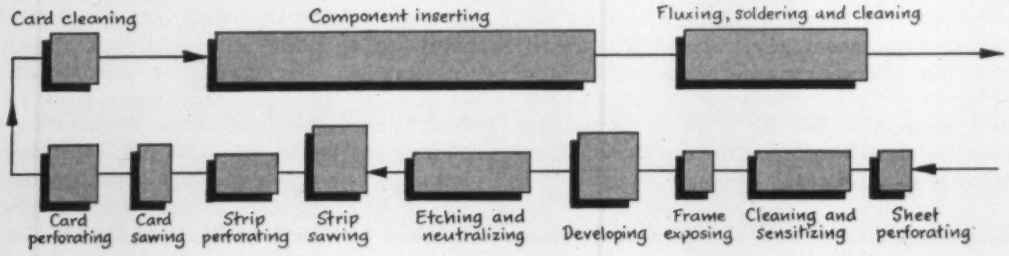


Fig. 2—Graph comparing production rates for table radios under alternate methods of manufacture.

1. Shorter lead time, particularly for moderate to large production lots.
2. Requirement of fewer moderately skilled operators for a given production rate. (Since all operations cannot be made automatic, increased production with automatic equipment will usually increase the number of operators, but productivity will also be increased.)
3. Requirement of greater number of higher skilled operating personnel.
4. Higher efficiencies (99.6 per cent obtainable for certain machines).
5. Less wasted material.
6. More effective utilization of space.
7. Increased production potential.

Based on a talk to the Conservation Conference of the Rochester Air Procurement District, Sept. 1956, in Rochester, N.Y.

Fig. 1—Sketch of units incorporated into an automated system to produce electronic assemblies using printed wiring boards and standard components.



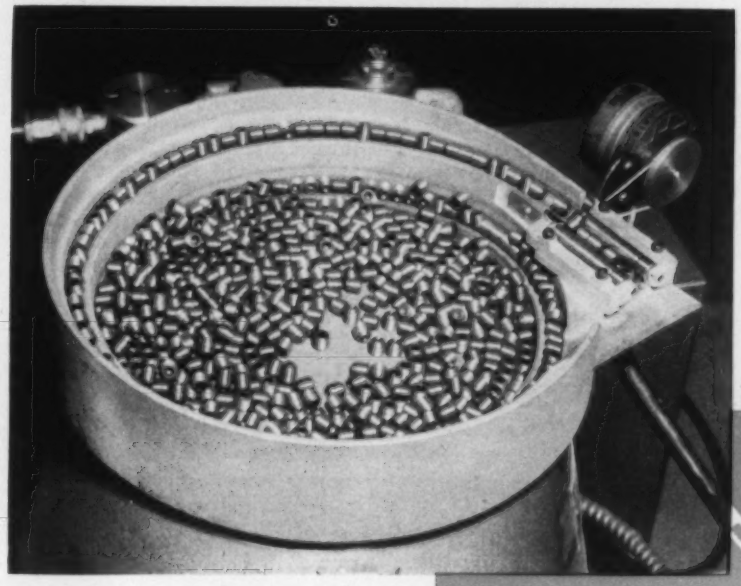


Fig. 1—This combination of a vibratory feeder and a standard orienting mechanism can supply a flow of oriented setscrews to any operation. The orienting device mounts directly on the feeder bowl and is actuated by the small electric motor visible at upper right.

DESIGN DEVELOPMENTS PERMIT

AUTOMATIC SETSCREW DRIVING

Reliable equipment for feeding and driving headless setscrews has a place in many assembly operations. Standardized components to perform these functions have been developed and are adaptable to a wide range of applications. The author discusses some of these developments.

By **CALVIN BROWN,** President, Set Screw & Mfg. Co., Bartlett, Ill.

THE WORD *automation* has become a symbol of a new phase in the continuing industrial evolution that has made America the world's prime producer of capital goods. Application of automation has created tremendous economies and boosted production rates in the fields of materials handling and manufacturing. Because of the difficulties involved, one area that has lagged behind has been that of assembly operations. About three years ago, Set Screw & Mfg. Co. came to the conclusion that automation in setting and driving of headless setscrews had to be accomplished in order to reach desired assembly goals. It seemed that our engineering familiarity with setscrews and their manufacture logically nominated us for the task of developing and perfecting a system for hopper feeding setscrews in assembly operations, and so we began development work.

Several systems were developed which included the use of very special types of setscrews. Although these worked, they left some things to be desired. But this experience showed us what we needed, and our present orienting device was evolved and perfected. As it now stands, a complete system for hopper feeding headless setscrews is amazingly simple and therefore, trouble-free. Minute, indistinguishable changes in the setscrew design assure proper orientation.

Standard Components

The big problem in hopper feeding headless setscrews is proper orientation. The orienting device

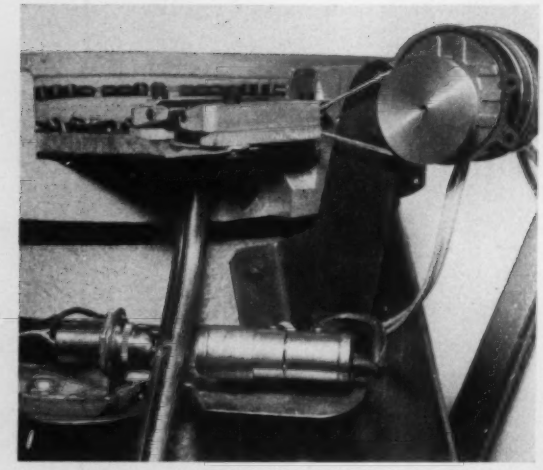


Fig. 2—Level of setscrews in the feed tube leading from the orienting device to the screwdriver can be sensed by means of a photoelectric arrangement as shown. This device can turn off the feeder and orienter to prevent jamming.

shown attached to a vibratory feeder in *Fig.* 1 consists of two rollers that form a trough and rotate slowly in opposite directions. A vibratory hopper is used to "march" the setscrews in single file up to and onto the trough. The setscrews then pass along the trough formed by the rollers to a point where matching grooves in the rollers allow the setscrews to drop into the feed tube with heavy point ends down. The rollers themselves are driven by a tiny, low powered electric motor similar to those found in electric clocks. So successful is this orientation device, that one automotive manufacturer is using such a unit to hopper feed setscrews that are wider than they are high. The device actually rejects improperly positioned or damaged setscrews.

The simplicity of the design assures that the orienting device will require virtually no maintenance, and since the moving rollers are not stressed, there is no lubrication or bearing wear to consider. The rollers are made of high quality hardened tool steel and wear is negligible since the rollers do not touch, and support only the weight of the setscrews passing over them. The rigid casting that supports the rollers fastens directly to the rim of the feeder hopper and can easily be removed if desired.

A photoelectric cell is used to control the number of setscrews in the feed tube to prevent overflow or jamming of the orienting device. The photoelectric cell is located at a specified position on the tube, *Fig.* 2, and shuts off the vibratory feeder when the tube is filled to that point. As the assembly operation uses up the screws in the feed tube, the vibratory feeder starts up again and maintains a constant, uninterrupted supply of setscrews to the driver. For operations involving cone pointed setscrews that might have a tendency to nest in the feed tube, a separating device has been provided that breaks up such nesting action and feeds the setscrews to the driver one at a time.

Setscrews are escaped from a feed tube one at a time and positioned for horizontal driving by a transfer mechanism shown in *Fig.* 3. The control rod which moves the transfer bar is actuated just before the screwdriver spindle advances far enough to pick up the setscrew and drive it into a tapped hole.

For many subassembly jobs a standard adjustable worktable or workholding fixture such as shown in *Fig.* 4 can be used. The worktable in this use has been tilted from back to front and

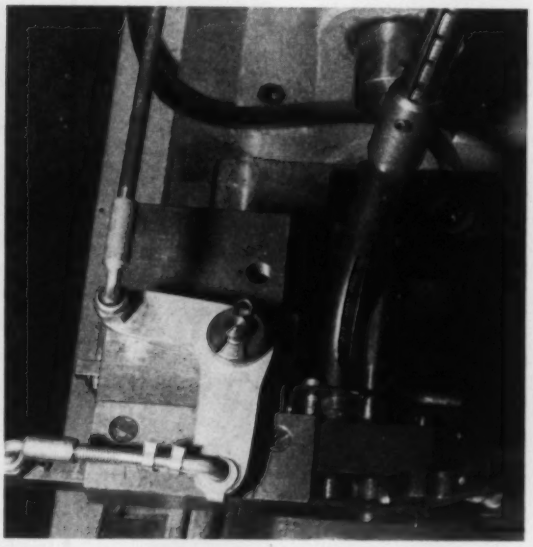


Fig. 3—Escapement such as this simple mechanical device transfers one setscrew at a time from the feed tube into position in front of the screwdriver spindle. Actuation of the transfer slide is mechanically linked with spindle advance.

from left to right for an operation driving setscrews into a pulley. The tilt in the worktable was set up to get around the pulley flange. Such vertical and lateral adjustments in the table make it usable for many different sizes and shapes of workpieces.

Air feed of the screwdriver spindle is utilized because of the smoothness of operation it provides. Also, it has proved to be the lowest cost, dependable source of power for advancing the screwdriver. Limit switch controls are used to actuate the driver immediately on presentation of the workpiece in a subassembly operation, such as shown in *Fig.* 4. Limit switches may also provide a safety margin to protect machine, workpiece and operator in this manner: should the workpiece be incorrectly positioned, incorrectly drilled or tapped, the setscrew will not drive in a normal

driving time and a second limit switch will cancel the driving action and return the driver to its rest position. The operator can easily correct the workpiece on the table, or reject a bad part.

Application Considerations

Although horizontal driving is usually the best choice for most operations, vertical feed designs adapted to drill press or vertical tapping machine operations have solved some unusual problems. One of these involved an electrical terminal part for an appliance maker. This workpiece required the driving of four setscrews at two different levels. By adding a special fixture and mechanical cam, a highly successful installation was developed in which the operator inserted the workpiece and the equipment then indexed to drive all four setscrews and eject the completed subassembly into a box. An arrangement for use in vertical driving of set screws is shown on a drill press in *Fig.* 5. Here again, release from the feed tube is mechanically linked to movement of the screwdriver spindle.

Both horizontal and vertical feed arrangements can successfully hopper feed setscrews as small as No. 2 (0.086 inch by ⅛ inch). To alter either horizontal or vertical arrangements for different sizes of screws, the user can simply change the feeder hopper, the orienting device and the feed tube to the proper size.

Perhaps the best way to indicate the versatility of hopper feeding of setscrews is to show an installation which is part of a rotary indexing machine, *Fig.* 6. This operation utilizes an adaptation of a horizontal arrangement with air feed. The operation is automated to a point where the operator simply places the workpiece on the worktable which then automatically indexes to drill the hole, tap it, insert and drive the setscrew to predetermined depth, and finally, to eject the completed subassembly into a parts bin ready to go to final assembly.

These systems for hopper feeding of setscrews have been in use in a variety of industries including manufacturers of industrial equipment, automotive manufacturers, appliance makers, etc. They have helped bring automation to subassembly of knobs, pulleys, window cranks, electrical and electronic components, light fixtures, and other parts. In almost every case, a job that now involves tedious, low production, hand work can be automated with such a system for hopper feeding headless setscrews.

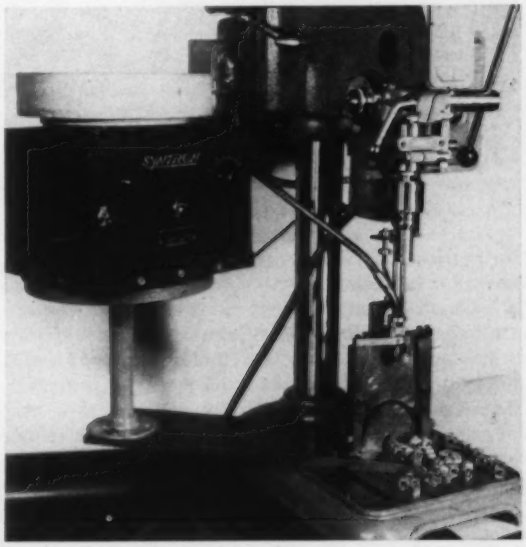


Fig. 5—Automatic equipment for feeding of headless setscrews was applied in this installation having a screwdriver spindle operated vertically by a drill press. Such an arrangement can also be used on vertical tapping machines.

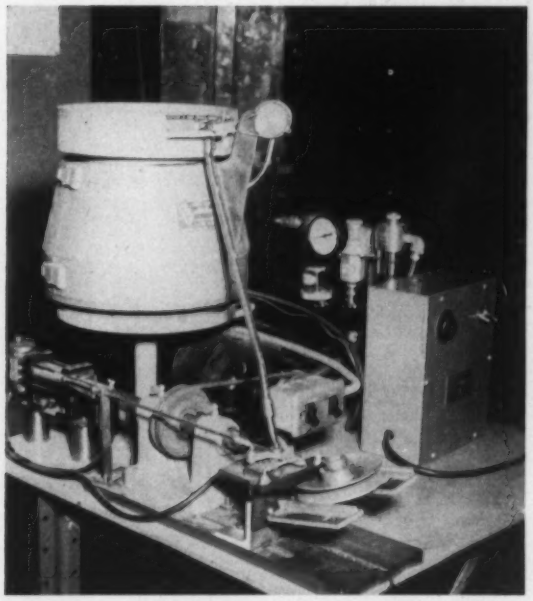


Fig. 4—This pulley subassembly setup feeds and drives a setscrew to predetermined depth in the hub. Equipment components are standardized items adapted for this particular operation.

The benefits that an automated system provides are carried over into final assembly operations. Hand driving of setscrews produces results which are not uniform: the setscrews are either driven too deep, requiring back-off for final assembly; or they are not driven deep enough and can work loose and fall out before final assembly. With an automatic system, each individual setscrew can be driven accurately to a predetermined depth. This speeds up the final setting of the screw in

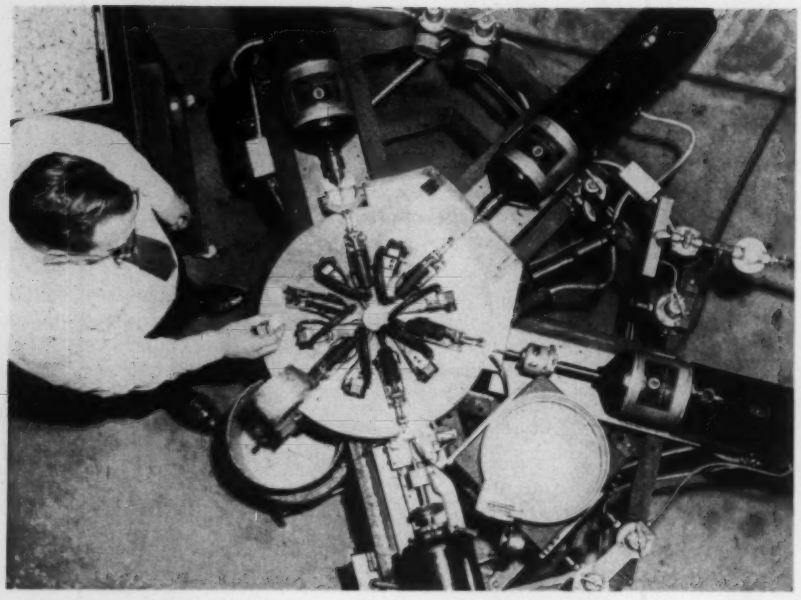


Fig. 6—On this rotary indexing worktable, the workpiece is automatically drilled and tapped, a setscrew is inserted and driven, and the subassembly is ejected into a container.

assembly and puts an end to fishing around in a parts box for loose setscrews.

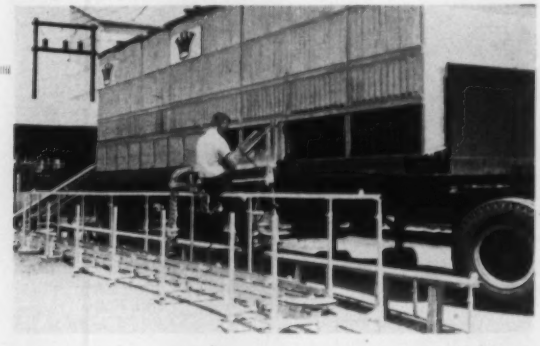
Automating setscrew operations can be carried still further. Systems can be incorporated in final assembly to insert, drive and set the setscrew on the shaft at any predetermined torque. Used in this manner, the system eliminates one step in subassembly and improves final assembly. As with other types of automated equipment, each installation has some of the features and characteristics of custom made machinery. In most cases, a machine is not built until the workpiece has been studied and a decision reached as to which design is best, and what special requirements must be met.

A big advantage in installing an automated system is, of course, increased productivity of each worker. Users report savings of 80 to 90 per cent in operational time. In one vertically-fed machine, hourly production went from 300 pieces to over 2100 pieces. Our experience shows that this type of increase is a conservative figure and that in many cases improvement will be even greater.

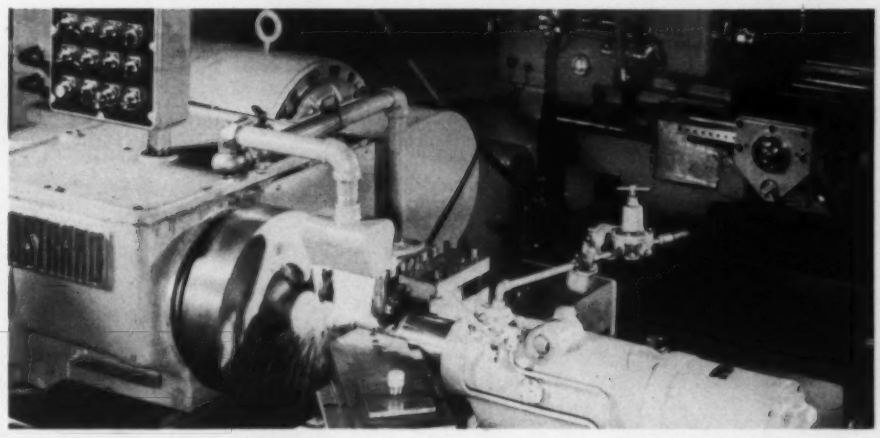
Worker morale is important, too. One manufacturer found it virtually impossible to keep workers on the tedious job of hand driving of setscrews. Since installing a new system for hopper feeding, this problem has vanished. Not only that, but the floor space required for each subassembly operation of this type has been reduced.

Can Delivery System

UNIQUE transportation link between can manufacturers and users has been developed by Crown Cork & Seal Co. The system utilizes special self-discharging can containers which can be transported by conventional flat bed highway trailers. Eight of the large containers, which are handled by fork lift truck, can be located on a trailer. Each special container is fitted with 11 vertical cells and is made with a pitched bottom so that the load will be self-discharging when the cell gate is opened. The cans are fed automatically into the cells at the can plant and are oriented with open ends facing one direction. At the user's plant a wheeled track set in a raised concrete platform transfers the cans from the containers to a cannery filling line via a cableway extension. Typical delivery methods



normally require considerable manual labor when cans are received or special machinery is required to organize loose cans so they face in one direction. With the Crown system, an average of 1200 16-oz cans per minute can be unloaded and trial runs have indicated that 2000 per minute is a possibility.



Courtesy Sundstrand Machine Tool Co.

COOLANTS FOR AUTOMATION

By **JOHN A. BOYD,** Vice President, Van Straaten Chemical Co., Chicago, Ill.

SUCCESSFUL AUTOMATION is based on study and perfection of individual machining operations and then placement of these separate operations into an orderly sequence. The same analytical approach used in setting up an automation line is needed in the selection and development of a coolant for these operations. Analysis and perfection of different characteristics are needed in the selection or development of an automation coolant. Such functional analysis is beginning to pay off for several large industrial plants with automated lines.

Five Elements

The automation coolant, to be successful, requires development of five elements. Each element must be refined to fit the special requirements of the automated line, improved to the maximum and then delicately balanced in relation to each other element.

The first requirement of a satisfactory coolant to be studied is its *film characteristic.*

In individual machine operation, film characteristic of the coolant can be relatively unimportant. In an automated line, it is one of the prime elements that must be considered. The film residue characteristic of a coolant may range from the hard, granular, crystalline type left by the synthetic fluids all the way to the soft, oily films obtained with mineral oil based compounds.

The hard, crystalline residue may offer no problem in the individual machine, but on the automated line, these deposits may accumulate on the gages or fixtures. In time, these deposits can throw off the entire process with incorrect gage readings. Daily or weekly maintenance may be required to insure proper free functioning of mechanical parts and gages.

Therefore, the major requirement of film characteristic for an automation coolant is a film which permits moving parts to remain in good working order so that they will not in any way interfere with the function of the line.

The second element to consider is the *lubrication quality* of the coolant with regard to the moving parts of the machines. This can range from insufficient lubrication of many of the synthetics to the full film type of lubrication obtained with some oil base compounds. Because many of the moving parts and gages used in automated setups will require fluid film lubrication for continuous functioning, the water soluble compounds should be selected with this point in mind.

The third element is *stability.* In the case of the individual machine, lack of stability and possible spoilage of the coolant is not catastrophic. After all, it would only shut down one machine at any time and plant production would not suffer to any great extent.

Most of the larger automated units are fed from a central coolant system. Should this central system coolant become unusable, the line would be shut down—while from 5000 to 50,000 gallons of coolant were emptied and replaced. Production might be lost over an entire shift. Thus, stability of the coolant becomes of major importance.

The plant with an automated line fed from the central coolant system must have a compound

which will remain stable and in functioning condition for a reasonably long period of time. Standards of stability range upwards from three months with the newer coolants. Coolants guaranteed for three month stability can last more than a year.

The fourth requirement of the compound for automated lines is its *cleaning ability*. If the coolant permitted a build-up of sludge or chips around the moving parts and fixtures, eventually the machine's functioning would be impaired or stopped. Therefore, the coolant should have sufficient detergency to remove any sludge deposits and keep the fixtures and gages free.

The quality of detergent cleaning must be balanced with that of fluid film lubrication. Without this balance, satisfactory functioning of an automated line is impossible.

Last, a quality is available today in a few of the most recently developed water soluble oil coolants—the quality of being *multipurpose*. In the future this will be demanded for all automated production.

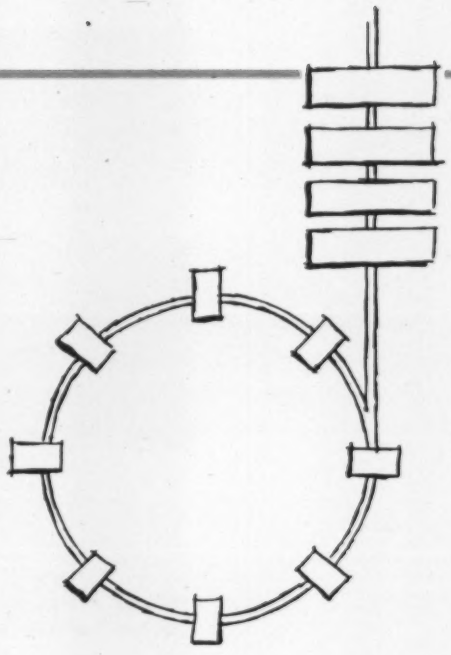
In the past a cutting compound was used on cutting operations and a grinding compound for grinding operations. Many automated operations still operate with all the cutting operations supplied with cutting compound from one central system and the grinding operations supplied by a separate system carrying a grinding compound.

As more and varied operations are tied into a single production setup it becomes apparent that a compound that will handle both cutting and grinding operations is needed. It must not only handle both cutting and grinding but it must function effectively on a wide variety of operations. In the case of cutting, it should handle tapping, drilling, and milling as well as general turning. In grinding it should handle different metals over a wide wheel range.

Fortunately, recent developments in the technology of compounds have brought forth products which have extremely good lubricating characteristics for cutting operations and at the same time provide the cleaning characteristics needed to keep a grinding wheel clean and free cutting. This combination answers the problem of combining cutting and grinding operations satisfactorily into a single system.

▸ Keeping Pace

These five qualities—film characteristics, lubrication, stability, cleaning ability and dual purpose—distinguish the compounds that may be considered as automated line compounds. The high stage of development of each of these functional qualities, made possible by recent developments in lubricant technology, is making it possible to keep pace with the new demands of industry. New water soluble compounds are moving into the field to handle the problems created by the development of automated lines.

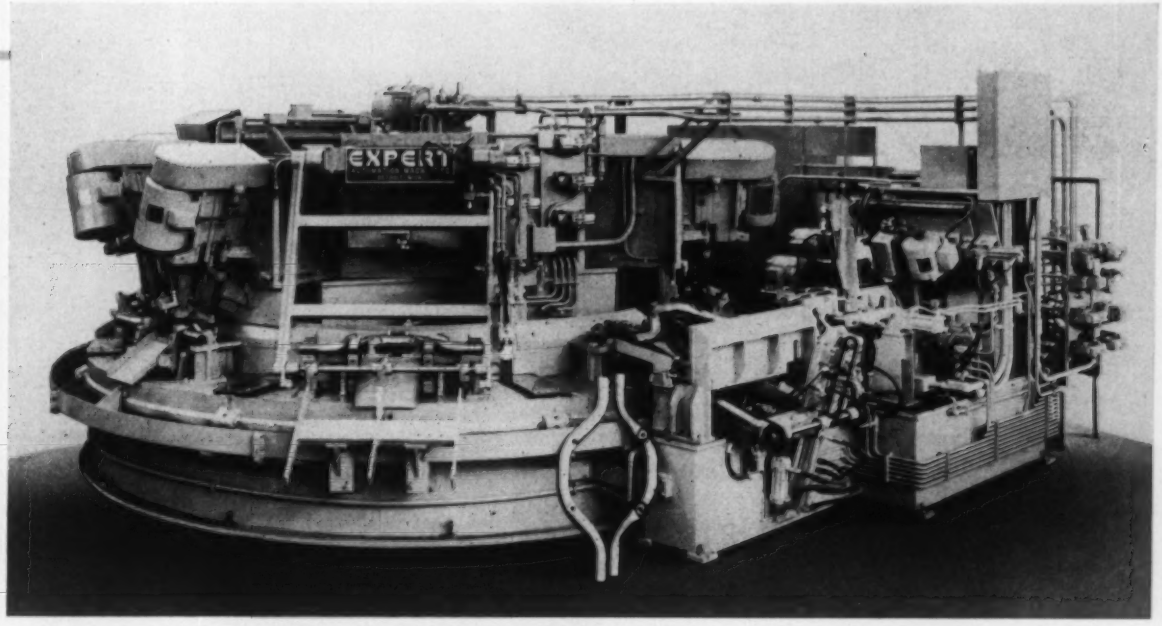


SINGLE MACHINE COMBINES STRAIGHT LINE AND ROTARY INDEXING

MANY FACTORS influence the selection of machine configurations for multistation special machines. The sequence of operations to be performed, the size and shape of the workpiece, the shape of standard components that are available, and the floor space allotted for the equipment are points of prime consideration.

▸ Large Combination

Drilling, spotfacing, reaming and deburring operations on 39-inch long, 2⅝-inch outside-diameter bent tubular steel automotive frame cross members are performed on a 12-station machine designed and built by Expert Automation Machine Co. The first four stations are of the straight line



Automatic 12-station drilling machine combines straight line transfer and rotary index machine concepts to drill, spotface, ream and deburr holes in automobile frame cross members. Rotary table is 12 feet in diameter.

type and the remaining eight are of the center column rotary index design. This arrangement requires minimum floor space.

Although weight and inertia loads are usually said to limit the maximum diameter of rotary indexing machines, the influence of other factors may set the final design limitations. To accommodate these frame members in eight stations on a rotary machine requires that the table be 12 feet in diameter.

The table used is made of cast aluminum sections that are fastened together. Use of aluminum instead of steel for this fabrication accomplished a weight saving of 6000 pounds. This condition allows the table to be moved by a mechanical cam index mechanism powered by a 2 horsepower motor. The machine automatically cycles to produce 200 pieces per hour.

▶ Machining Cycle

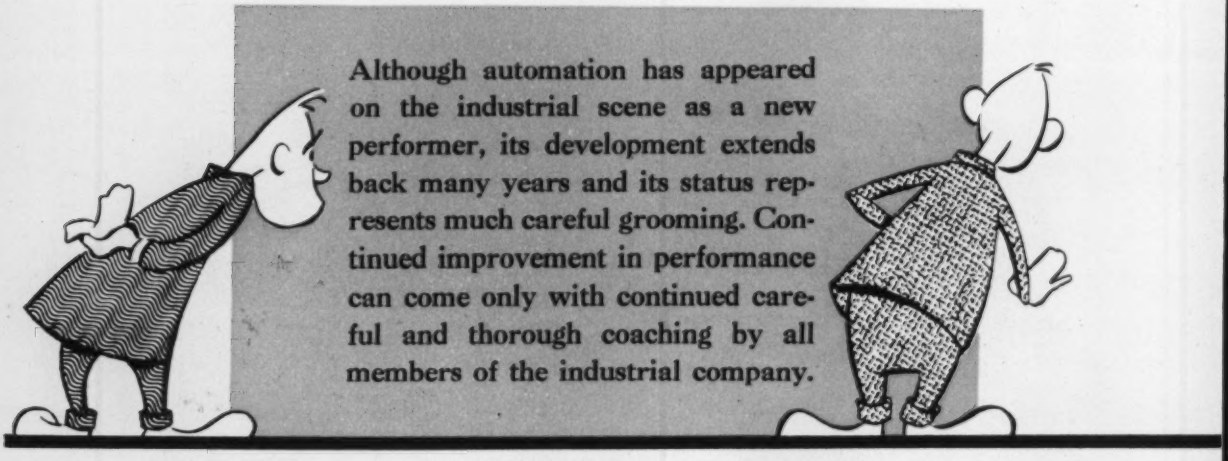
Parts are loaded into the first station of the straight line transfer section of the machine. Then they are moved by a hydraulically operated pusher bar mechanism to the next station where five holes are drilled in three planes in the part. Next the part is transferred to a third station where the five drilled holes are probed to check for incompleteness due to drill breakage. Any holes that are not finished cause the machine to shut down. In the fourth station a handling device operated by two hydraulic cylinders removes the part from the straight line section and transfers it to the first station in the rotary section.

The parts are first clamped by a cylinder-operated device which includes an over-center toggle mechanism and leafspring control that provides approximately constant clamping pressure regardless of variations in the contours of successive parts. The table is next indexed to the second station where holes are drilled through two reinforcing plates that are welded to the frame member in angular locations. In the fourth station, drills enter these same two holes and make holes through the wall in the opposite side of the tube.

The two reinforcement faces are spotfaced in the fifth station. Then the two holes are reamed. The drive that feeds the reamers through these holes is controlled in such a manner that after the reamers emerge inside the tube they rapid traverse to the opposite side and then slow down to cutting feed again. This "jump feed" action shortens the overall cycle time. The outside edges of the holes are deburred in the seventh station.

Parts are unloaded from the machine at the eighth station by another handling mechanism operated by two hydraulic cylinders.

This combination of straight line and rotary indexing sections in a single machine provides automatic machining advantages for these relatively large and awkward to handle parts.



Although automation has appeared on the industrial scene as a new performer, its development extends back many years and its status represents much careful grooming. Continued improvement in performance can come only with continued careful and thorough coaching by all members of the industrial company.

INVESTIGATE BEFORE YOU AUTOMATE

By **WALTER G. JOHNSON**
Manager of Research and Engineering, Grinding Machine Div., The Norton Co.

AUTOMATION is one of the pressing problems facing today's designers of machine tools. The problem includes more than designing of the equipment; it requires an educational program for plant managers, customers, the working forces, and many others who have little or no part in the actual design of equipment.

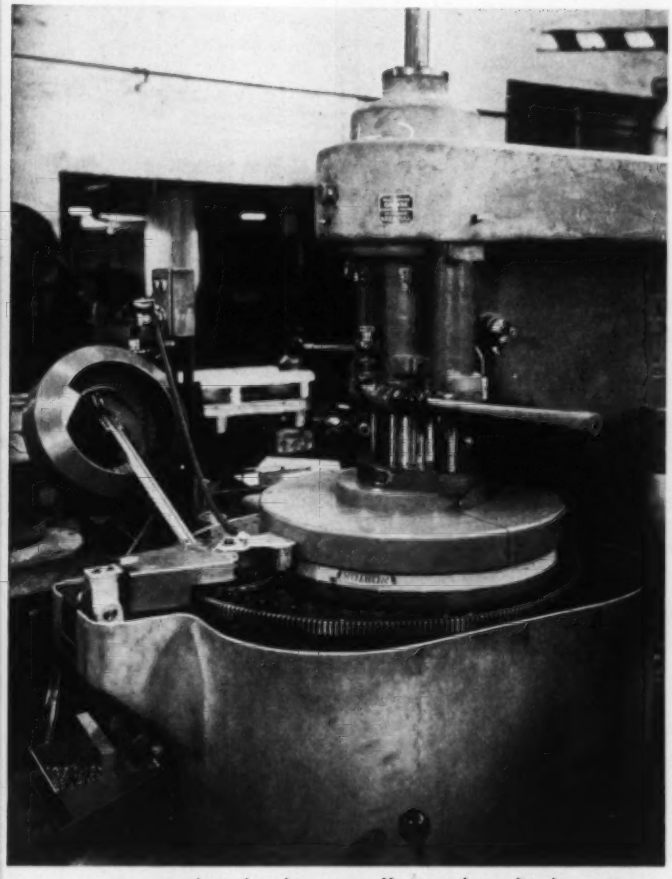
To the designer, automation is the continuation of a steady trend. At the present time he can design a machine to do almost anything if cost is no object. The Norton Co. has been making precision grinding machinery for 56 years. During this time there has been increased use of automatic controls directed toward the relief of operator responsibilities and fatigue. But suddenly we found ourselves in a new era called "automation." This word is difficult to define but we feel that automation is any method designed to increase human productivity, to operate with self-control, and to provide for product flexibility through processing of material or energy.

Looking back a number of years, we also find that there have been many examples directed towards increasing human productivity, control of quality, in addition to reduction of fatigue. In the field of grinding there have been automatic machines built as long ago as 15 to 20 years, without thought of the word automation, yet the function of the equipment was along the lines of the foregoing definition.

Earlier machines were manually operated; the individual provided physical skill and mental ability to secure the desired results and product. Analysis of the operator's actions gave the engineer the initial opportunity to attempt to duplicate some of his motions and activities by not too complicated mechanisms resulting in a gradual change of the original machine. The trend has been to include additional elements which make it easier to maintain production because of automatic control of the quality of the product.

▶ Economic Cause and Effect

Automation also appears to be continued progress toward providing means of increased human productivity. Any impression that increased human productivity minimizes the use of human labor to reach required production is an error. Our standard of living is a direct benefit of mechanized productivity. More demand is created because each individual wishes to enjoy the benefits and comforts which we commonly accept as part of our existence today such as the automobile, home refrigeration, regulated heat in the home, radio, television, and automatic facilities for housework. It is because these products have been made available at a reasonable cost that the individual has been able to obtain them. Greater productivity



. . . there has been no effort made to fix the extent to which automation should be utilized . . . This Norton lapping machine is equipped for automatic through feed of workpieces.

gives the possibility of less cost creating an attractive and sizable market.

Our population is continuously growing. This growth is causing additional demand for products to be produced. Many other service activities such as legal, medical, etc., have also increased, and in greater proportion. The result is that demand is increasing and the productive labor to satisfy the requirements is not increasing as rapidly as the demand. This encourages direction of engineering efforts toward automation.

It has been interesting to attempt to analyze the effect that automation has on labor—quite a controversial subject over the past few years. But the trend is definitely toward acceptance of automation in all quarters. A probable reason for this acceptance is the fact that automation tends to transfer labor into a more desirable function. Labor will be encouraged toward special training or special skills.

There has been no effort made to fix the extent to which automation should be utilized. In most cases, the situation has been such that automation was introduced gradually. This is natural because of the tremendous problem of making a push-button factory in which automation is utilized from the introduction of the raw material to the packaged final goods. There are great problems involved in transferring the skill of an operator to a machine. Also, progress occurs in orderly step by step fashion for investment reasons, as well as for reasons of getting direct experience in automation activities.

In grinding operations, the degree of automation may include work-load assist mechanisms with means for automatic sizing. Additional elements maintain better control of operating characteristics such as constant peripheral wheel speed or automatic truing. Some of these devices are refinements of ideas and mechanisms which were already available. Automation, designed into the grinding machine, is establishing controls which result in uniform productivity and particularly in uniform quality of the product. It should be noted that the direct labor element is not completely eliminated.

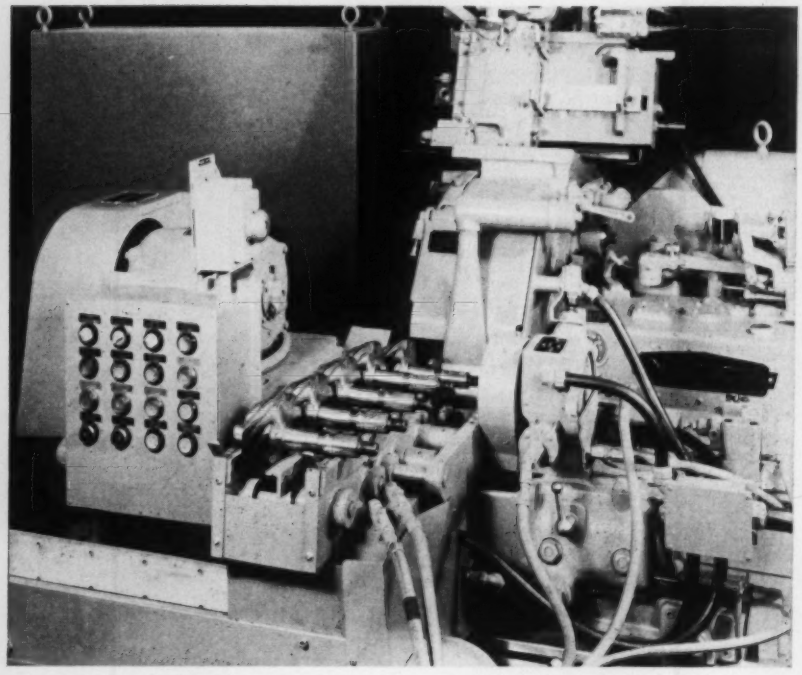
How Much To Automate

Initial attempts towards automation generally result in the recognition that each case presents its own special problems. Most mechanized units are tailormade or designed to suit a particular job, and involve high initial cost of equipment. This cost generally includes, in addition to that of mechanization, the cost of elaborate control circuitry. Maintenance of this equipment can be costly unless skilled maintenance people are available to minimize the down time of a machine. Maintenance is important because in most automated lines, a breakdown at any particular point may stop production on the entire line. For this reason, many plants have carefully established preventative maintenance programs, arriving at the frequency of inspection of units through a historical record of the tendency of various units to need attention. It is very important to recognize that there is economy in standardization of handling equipment because of the advantages of familiarity of maintenance.

Any effort to answer the question as to when automation should be adopted will require complete knowledge of the specific problem involved. It becomes a matter of deciding the degree to which special equipment can be considered. This might, in many cases, mean only a work handling device rather than a fully automatic system. Careful thought results in a design which not only satisfies the immediate problem, but provides for possible future modification to accept devices which will increase the degree of automation.

Dimensional Control

When analyzing an operation to establish the degree to which a machine will be made automatic, it is necessary to be thoroughly familiar with the final requirement of the operation, and also the conditions existing prior to the operation. Consid-

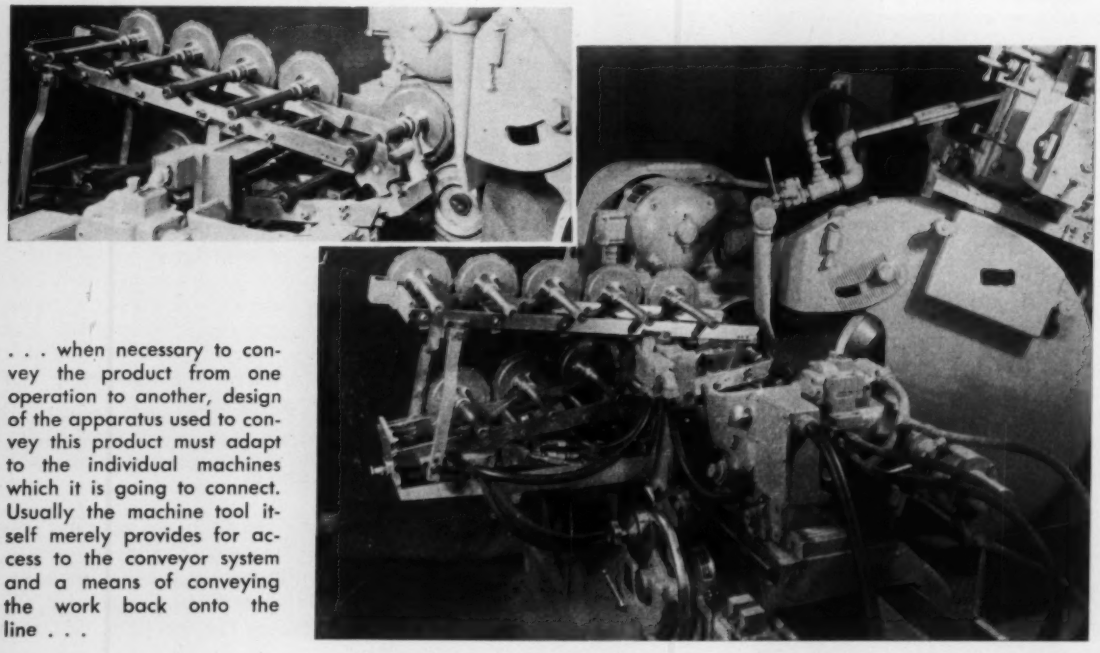


. . . it becomes a matter of deciding the degree to which special equipment can be considered. This might, in many cases, mean only a work handling device rather than a fully automatic system . . . This machine is tooled to grind pinion stems.

erations for automatic operation of a machine sometimes reflect back in several steps in the series of operations because of dimensional control in these previous operations or for other reasons.

It has been our experience in studying problems of automation to recognize the importance of providing devices which will constantly inspect the product being produced. If the product reaches an unsatisfactory status, the machine should automatically shut down. In many instances production can be at such a rate that the inspecting medium might be subject to variables within itself, and if this is the case, it is wise to have a secondary method of checking the product which also could cause shutdown of the machine, should machine operation so warrant.

There have been efforts made to automatically accomplish inspection on a basis of statistical quality control, recognizing that a certain band of tolerance is permissible, and it is necessary to know



. . . when necessary to convey the product from one operation to another, design of the apparatus used to convey this product must adapt to the individual machines which it is going to connect. Usually the machine tool itself merely provides for access to the conveyor system and a means of conveying the work back onto the line . . .

only when the area of performance is approaching the outside of the area of acceptance. In some instances, it has been possible to provide an automatic memory device which signals adjustments to compensate for a tendency to produce pieces close to the outside tolerance of the permissible band.

It is interesting to note that where a high degree of automation has been applied, considerable prominence has been given to inspection stations, both before the operation as well as after, using these stations in combination with by-pass equipment, or storage arrangements, to permit correction or adjustment without continued interruption of production. This, in many instances, calls for a great deal of instrumentation and special types of sizing or gaging devices. The economy and investment in these units is, of course, supported only by the ability to continuously produce a product of acceptable quality.

▶ Other Considerations

When automation is attempted in a unitized form (where one particular piece of equipment is automated) it is necessary to give careful consideration to the other related pieces of equipment which may be furnished by other manufacturers. When necessary to convey the product from one operation to another, design of the apparatus used to convey this product must adapt to the individual machines which it is going to connect. In most instances, this is a special field of engineering effort. Usually, the machine tool itself merely provides for access to the conveyor system and a means of conveying the work back onto the line.

The degree of automation is limited by the available plant layout or the spacing of equipment. This in itself can determine the degree to which automation is successfully applied. Where a new plant is planned, it is possible to increase the degree of automation, if space requirements are adequately foreseen.

Due to the size of the investment as determined by the degree of automation, it is necessary that full recognition be given to the distribution of this investment over the cost per unit of the product being produced. Therefore, the degree of automation will have a direct bearing upon the volume of work to be produced, as well as the depreciation period. Where model changes or design changes can be expected to occur frequently, the cost of altering the automated equipment may be high enough to prohibit consideration of a high degree of automation.

Recognizing the effect of down time, it is necessary to overdesign the equipment for extended life and continued performance of the mechanisms and operating apparatus. It is for this reason, that equipment involved in automation systems is rugged. Expensive equipment, beyond what might be normally required, may be necessary where the effect of down time is especially critical.

There is no simple packaged answer to the problem of automation. Considerable attention must be given to the many details of the subject before becoming involved in problems of design and actual investment in automation.

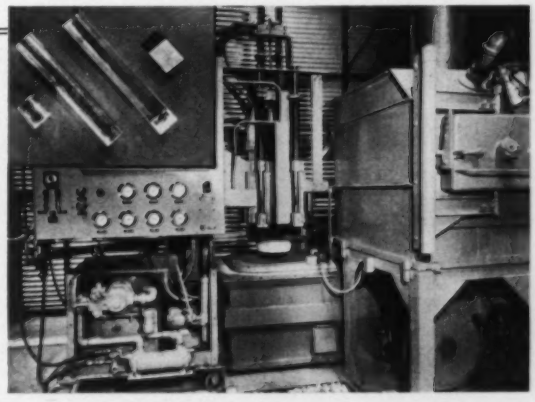
Casting Slugs Eliminates Scrap Losses

IMPACT aluminum extrusion has been greatly advanced by the development of a machine which produces slugs direct from ingots in one operation without scrap losses.

In impact extrusion, slugs of precision size and accurately controlled grain structure, free from porosity and other defects, are fed into presses which form intricate parts in one press operation. The slugs are normally produced by blanking from sheet or plate or by cutting off from bar or rod. However, these methods of slug production involve considerable scrap loss and create scheduling and manufacturing problems for a volume producer of impact extrusions.

Impax Inc., a totally owned subsidiary of the Universal Match Corp., is engaged in the design and production of impact extrusions. The need to improve the method of producing slugs has been apparent to this company for some time and the slug caster which has been developed answers the problem.

In operation of the machine, a multiple cavity water cooled mold is automatically immersed into a pot of molten metal and vacuum applied to draw the metal into cavities at a predetermined rate. At the proper point in the operation, the mold is simultaneously removed from the pot and the gates are cut off. The slugs are automatically discharged by hydraulically controlled knock-out pins in each mold cavity.



In the illustration, the mold mechanism is shown in the center just above the open pot and attached to vertical rods which lower it to the molten metal. A breakdown furnace in which ingots are melted is shown in the right foreground. The automatic control system for the furnaces and the hydraulically operated mechanisms are shown on the left. Shown in the insert are comparative views of one of the slugs and a part produced from it in an extrusion press and also views of a section of both pieces.

Machine operation is under the supervision of a metallurgical engineer to ensure the careful control of the cycle to obtain the desired grain size and product uniformity.

PROXIMITY SWITCH CONTROLS FEEDER

PROXIMITY sensing devices are particularly useful in controlling automatic feeding equipment. Practical operations in many production lines require that the feeders ahead of conveyors or chutes operate only when parts are needed or can be accommodated. Where frequent starts and stops occur, the remote sensing ability of proximity switches eliminates problems associated with wear normally experienced with mechanical switch type controls—an important feature in obtaining trouble-free production on a continuous basis.

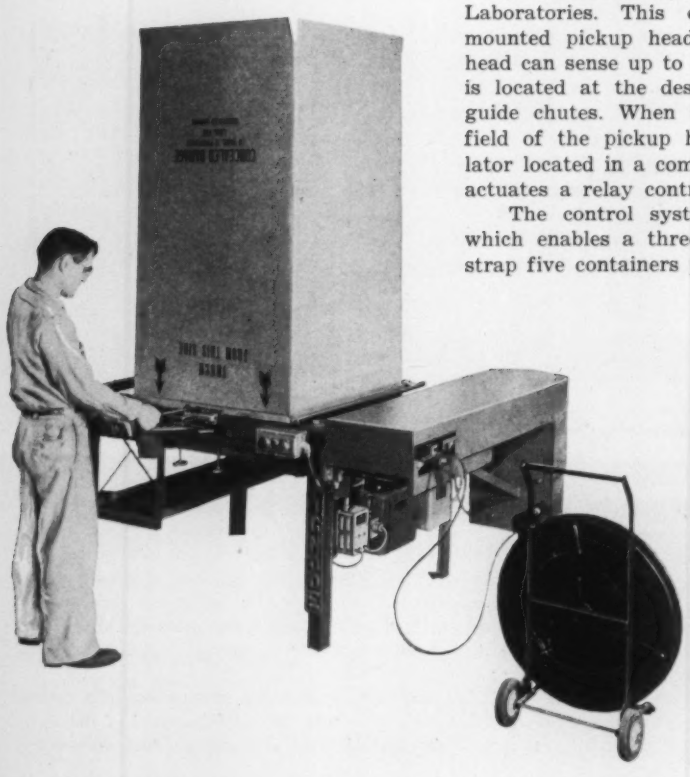
An interesting feed control application of a proximity transducer system is contained in a power strapping table developed by the Signode Steel Strapping Co. The equipment is designed for circumferential strapping of large interlocking flange containers widely used by appliance manufacturers. The metal strapping is coated with nonconductive material.

Operation of the power strapping table is relatively simple: While a container is being positioned on the table, a power drive feeds the strapping from a reel to a guide chute located along the edges of the table. This chute positions the strapping completely around the container in the proper position relative to the desired location of the strap. An operator presses a button which actuates mechanisms to tension the strap around the container after which the strap is sealed and cut off.

From a control standpoint, the designer of the equipment was faced with the problem of developing means to sense the leading edge of the strapping after it makes its circuit around the chute and also to control the strapping feed motor. The nonconductive coating of the strapping complicated the possibility of using a contact device.

As a solution, the table has been equipped with a proximity transducer system manufactured by Electro Products Laboratories. This company developed a special bakelite mounted pickup head for use with strapping material. The head can sense up to 1000 metal objects per second. This head is located at the desired point at the end of the strapping guide chutes. When the end of the strap comes within the field of the pickup head, it causes a radio frequency oscillator located in a companion control unit to stop. This in turn actuates a relay controlling the motor of the strap feed.

The control system is an important contributing factor which enables a three-man team to consecutively set up and strap five containers per minute on the power strapping table.



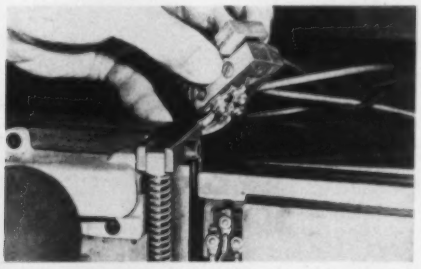


Fig. 1—Strapping is fed from reel by power drive mounted on table. The strap is guided around sides of container by guide chutes; when leading edge comes within field of pickup head (see insert) it causes the strap feed drive to stop with strap in correct position.

VOLTAGE REGULATION

By JAMES R. WALKER
Director of Research
Gemco Electric Co.
Detroit, Mich.

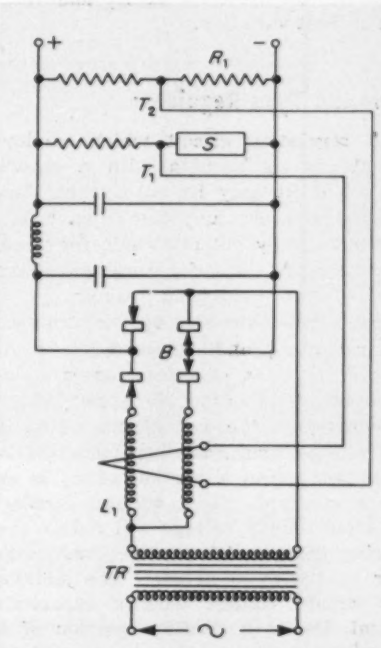
STABILITY requirements for electrical power have increased, paralleling its increased use by industry. Proper and continuous operation of components in complex electrical circuits is possible only when actual conditions equal design conditions. To obtain the requisite sensitivity and repeatability in machine, relay and other equipment operations, system designers are forced to reckon with voltage regulation. The application of magnetic amplifiers and other magnetic components to voltage regulation are covered in these notes—the last of a series of six such articles based upon use of magnetic amplifiers in industry.

Series Type Regulator

For ac or dc power supplies in which no more than 150 va output power is required a series regulator circuit similar to that shown in the illustration may be employed. Here a doubler-bridge type magnetic amplifier furnishes controlled excitation to a rectifier bridge B and filter circuit. A portion of the filtered dc output is developed across a linear resistance R_1 and a nonlinear resistance S. The signal voltage existing across terminals T_1-T_2 of this network is proportional to the difference existing between a portion of the output potential and a reference potential provided by the standard resistance S.

If the output voltage component predominates over the standard voltage, then the polarity and magnitude of signal in the control circuit of L_1 will be such as to increase its reactance and thus lower the output voltage. Such a series of events would occur, for example, upon a rise in the power supply input ac voltage or an increase in the load resistance placed across the output terminals of the rectifier supply. The regulating action is then seen to occur in a manner necessary to reduce an existing error current in the control circuit to zero.

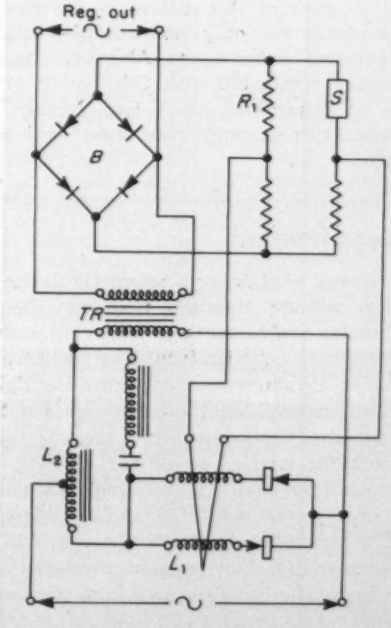
This type regulator can be used to supply reference potential for small testing fixtures, generator field excitation, and battery charging.



SERIES TYPE REGULATOR

Buck-Boost Regulator

The circuit of a buck-boost type regulator may employ a magnetic amplifier and voltage feedback network similar to that shown for the series type regulator. The major difference between the two circuits lies in the use of the associated saturable reactor L_1. The saturable reactor in the series regulator merely acted as a simple series reactance to limit the voltage applied to the load circuit. With a series regulator the output voltage of the regulator must always be derived from a transformer in order that sufficient voltage be available for the cases when the output voltage is gerater than the supply voltage. And in the buck-boost circuit it is not necessary that the supply voltage be greater than the output voltage since the buck-boost transformer L_2 provides a means of increasing the line voltage according to a preset voltage level of standard resistance S. This regulating means is used with both ac and dc supplies up to 5 kw in size.



BUCK BOOST REGULATOR

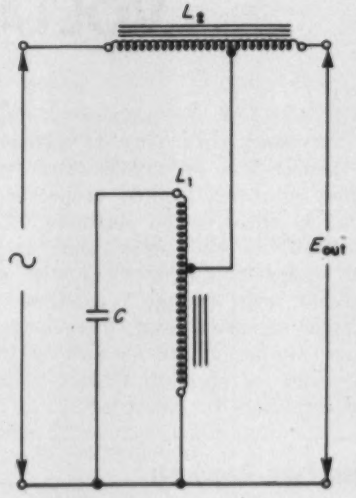
In the case of ac regulators a third and fifth harmonic filter is often placed across the linear reactor L_2 to remove the principal harmonics present in the ac output due to the saturable iron components present in the regulating circuit.

Regulation of 60-cycle supply lines with a ± 10 per cent voltage variation can be reduced to ± 0.5 per cent variation at the regulator output with a single stage of magnetic amplification in L_1 and for all conditions of load current variation.

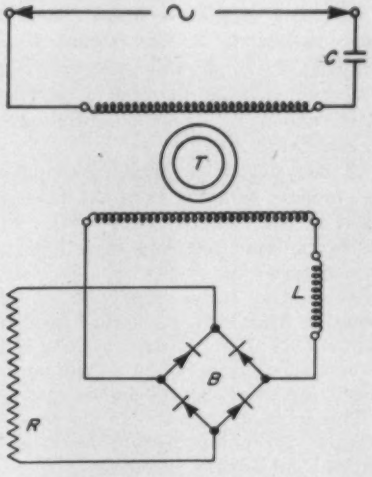
Harmonic Type Regulator

A regulating circuit which employs magnetic components in combination with a capacitive reactance is illustrated. It may be noted that this circuit does not utilize a magnetic amplifier as such. In this circuit a rise in input supply potential will, for example, cause an increased saturation of saturable reactor L_1 with no influence on nonsaturable reactor L_2. Since the nominal output voltage for this system is obtained when the reactance of L_1 and condenser C are the same, the described condition of saturation in L_1 causes the parallel reactance combination to appear inductive in nature. As a consequence the combination of an increased line supply voltage and retarding inductive voltage component developed across a portion of L_2 is sufficient to maintain a constant output voltage. Similarly a reduction in the input supply voltage will reduce the saturation of L_1 causing the parallel reactive combination of L_1-C to appear capacitive in nature. The addition of this reduced line supply voltage with a capacitative voltage component developed across a portion of L_2 then results in an output voltage which is approximately constant and higher than the line supply voltage.

In comparing this circuit with the series or buck-boost regulator, it must be noted this is an open loop compensator while the others were closed loop regulators. Because of this difference the harmonic type regulator circuit can only compensate partially for all possible external disturbances. Although the line voltage compensation attainable with this circuit is ± 0.25 per cent with $\pm$ 15 per cent line voltage change, the load current compensation is very poor even at constant input line voltage.



HARMONIC TYPE REGULATOR



VOLTAGE STANDARD

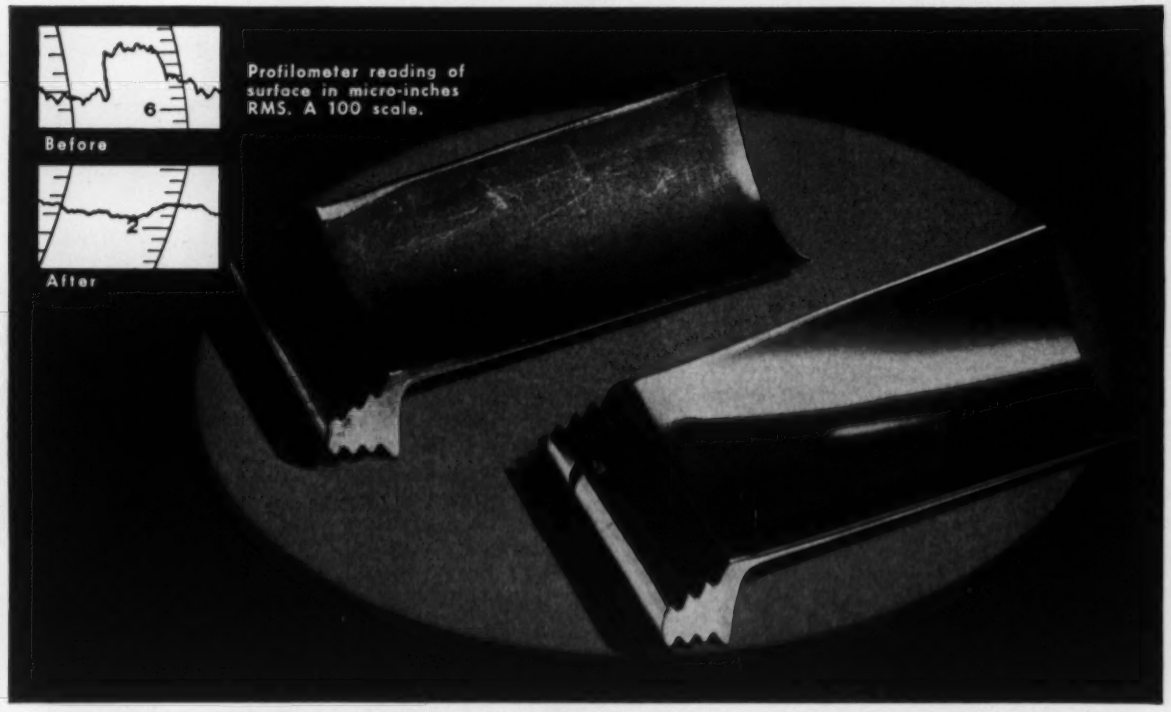
Voltage Standard

A circuit containing a magnetic device can provide a voltage standard that may be used for calibrating instruments or as a low current supply for other applications. The illustrated circuit provides a compensated output potential for line voltage changes but the circuit does not regulate in a closed loop manner. Compensation occurs because the ac flux swing for a square flux-current loop magnetic material is constant for all higher voltages after the applied voltage is just sufficiently high to cause positive and negative saturation flux density to be reached in the core.

Because the ac flux swing is constant in amplitude, the secondary voltage of a transformer using this core material is also constant. Thus the secondary voltage may be used as a standard for the suggested applications.

Since the secondary voltage of this transformer is proportional to the exciting frequency then it is necessary to further compensate the output for this dependency. This is accomplished by means of the linear inductance L. For example if frequency increases, the inductance causes a reduction in the output of the voltage standard by virtue of its increased reactance with frequency which is in the same magnitude as the rise in transformer secondary potential with this same increase of frequency.

Voltage standards of this type have been designed for output voltages to 50 v and for currents as high as 0.5 amp.



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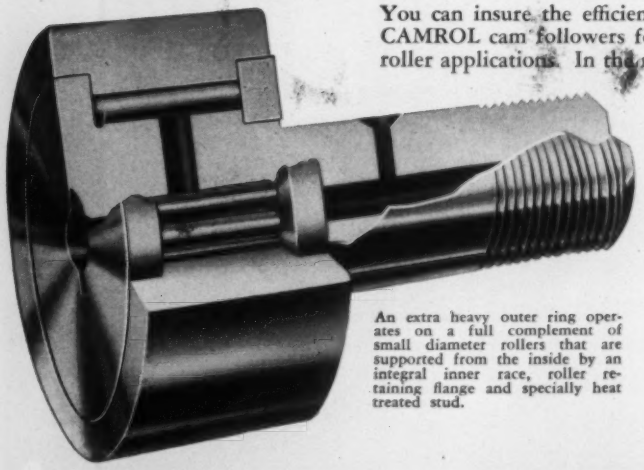
AUTOMATION TIPS by McGill

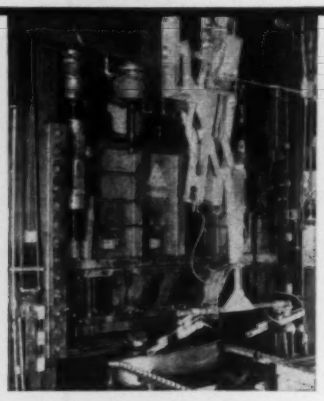
Insist on CAMROL bearing advantages when planning your automation

TRADE MARK



An extra heavy outer ring operates on a full complement of small diameter rollers that are supported from the inside by an integral inner race, roller retaining flange and specially heat treated stud.

You can insure the efficiency of your automated production by specifying CAMROL cam followers for cam action, track roller or guide and support roller applications. In the machinery you specify or in your own automated operations, CAMROL bearing quality guarantees dependability and longer bearing life. Their ability to withstand intermittent shock and heavy radial loads, space economy, ease of installation, simplified lubrication and balanced hardness and toughness recommends CAMROL cam followers for the critical antifriction requirements of automation. You can eliminate downtime due to premature failures of improvised units or ordinary bearings. Insist on CAMROL CF or CYR (without stud) bearings. Both types are available in a wide range of standard sizes as are the sealed SCF and SCYR series.



Camrol bearings eliminate bearing trouble for Sahlin iron hand unloaders.

Sealed CAMROL SCF bearings on the upper arm assembly travel a confined cam track to provide direction and support for the unloading arm. Here the IRON HAND machine is shown removing 120 lb. bathtub blanks from a forming press onto a conveyor for additional automatic operations. The Sahlin Engineering Co., Inc. that supplies this unique press unloader to automatic press operations, adopting CAMROL can followers has virtually eliminated bearing replacement under all conditions.

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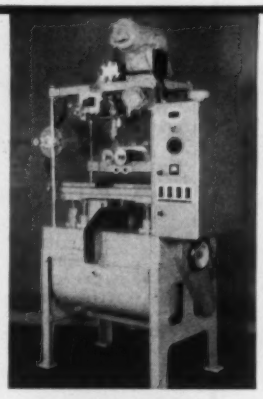


Camrol bearings show no apparent wear after three years use in automatic packaging machines.

The Kartridg-Pak Machine Co. uses McGill CAMROL bearings in the main drive mechanism of a packaging machine that also forms the container from thermoplastic film. This machine automatically forms, fills and closes 1800 packages of food or other semi-fluid products per hour. Dependability and accuracy of the free rolling and easily lubricated cam followers help guarantee the efficiency of these automatic operations.

After three years of use in this application, the CAMROL bearings show no apparent wear.

Camrol bearings assure greater speed and accuracy in shear-speed shapers.

Michigan Tool Co. uses CAMROL CF and CYR bearings in Shear-Speed Shapers that automatically produce gears up to 20 inches in diameter and up to 6 inch widths in only 13 minutes. These bearings, acting as cam followers, accurately control the feed of all cutting tools simultaneously and relieve these tools from the work on return strokes. They insure dependable, precision performance for automatic operations at high production speeds in these largest production gear cutting machines ever built.

Insure performance with McGILL®

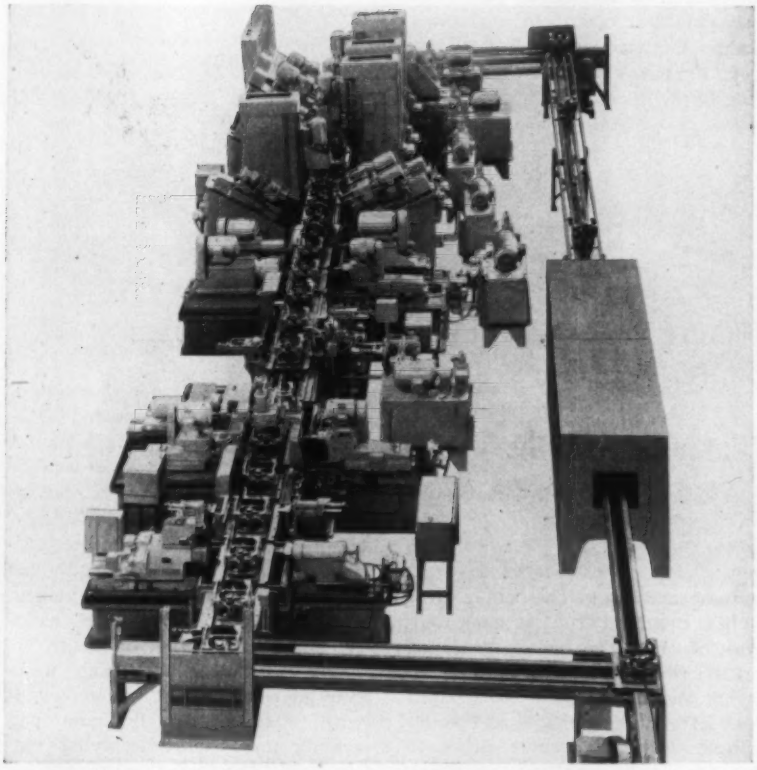
MULTIROL® GUIDEROL® CAMROL
Precision Needle Bearings

McGILL MANUFACTURING COMPANY, INC., 401 N. LAFAYETTE ST., VALPARAISO, INDIANA

AUTOMATION new equipment

Machines and plant equipment designed for more automatic operations

For detailed information and literature, use card page 17



Machining Automatic Transmission Extensions

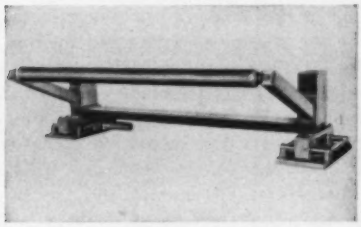
With a production rate of 180 pieces per hour at 100 per cent efficiency, 25-station Economatic completely machines two different automatic transmission extensions. Parts are automatically positioned and clamped in palletized fixtures. Shift from processing one part to another is done quickly by electrical selectors. The machine performs 30 operations, including drilling, tapping, rough and finish boring, automatic assembly of liners, automatic gaging, milling and facing.

Features of the machine include sectional base construction to facilitate future part changes; central mist lubrication on heads; automatic lubrication of all moving parts; interchangeable standard and special parts; arrangement of spindles for presetting of cutting tools to minimize downtime for tool changes; and detector system in the main console to signal and locate electrical failures instantly. **Buhr Machine Tool Co.**, Ann Arbor, Mich.

Circle 401 on Inquiry Card

Shiftable Cradles

Used for automatic edge guiding from an unwind or let-off, series of shiftable cradles is designed to utilize existing backstands and/or journals, shaft, and brake or tensioning devices. Most applications are made by removing these items from the machine and mounting intact to the cradle, which is then mounted directly to the frame of the machine or to the floor.



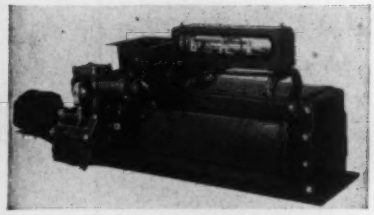
An idler roller is integrally attached to each cradle so that it may be shifted in unison with the unwind roll. The idler roller position on the units is customized to individual requirements. Automatic shiftable cradles are applied to slitting machines as well as other types of converting machinery. The cradles can be used with the Fife pneumohydraulic web guide power units to obtain guiding from the unwind into any type of web-fed operation. **Fife Mfg. Co.**, P.O. Box 878, Oklahoma City, Okla.

Circle 402 on Inquiry Card

Pneumatic Scale Feeder

Well suited for continuous blending or automatic batching operations, continuous gravimetric feeder utilizes pneumatic instrumentation. The feeder is controlled by a 3 to 15 psi air signal set manually or automatically in proportion to an air signal from an external source. The machine has a guaranteed minute to minute accuracy of ± 1 per cent over a 3 to 3000 lb per minute feed range.

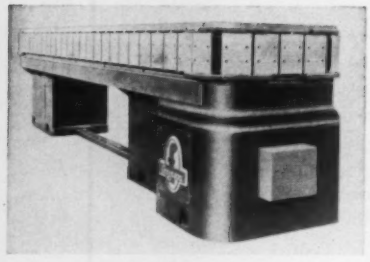
The feeder features recording and integration of feed rates from a measured air signal. Since the only electrical component in the



unit is a synchronous motor for driving the weigh belt, the feeder is suitable for use in hazardous locations. Adjustable over and under feed alarms are available.

In operation, the air pressure developed by the scale—known as the measured pressure—is applied to a pneumatic controller which compares the measured pressure against a set pressure representing the desired feed rate. Any deviation of the measured pressure from the set pressure is detected by the pneumatic controller. The controller adjusts the pressure output to a pneumatic positioner which controls the opening of a vertical gate in the feed control section. This control method enables the feeder to maintain a constant delivery of material by weight at the set rate. **Wallace & Tiernan Inc.**, 25 Main St., Belleville 9, N.J.

Circle 403 on Inquiry Card

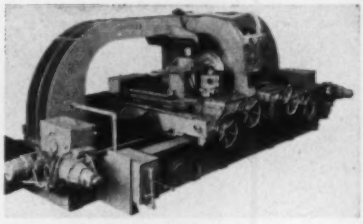


Transfer Machine Base

Used for automatic machining and assembly, line of standard Trans-O-Mator straight line transfer machines has been redesigned to widen the range of applications. Machines are available with strokes of either 6, 8, 12, 16 or 24 inches and with a choice of two types of carriers in various sizes. Standard lengths are 10, 14 and 18 ft. Other lengths can be provided by increasing or decreasing the span between end castings.

Carrier chain tension can be adjusted by either a screw take-up method or by a spring-mounted mechanism that automatically compensates for chain stretching. The power section, composed of a standard 2 hp gear motor, electric clutch-brake combination and cam indexing mechanism, is mounted as a single unit. A control panel contains an electrical interlock between the indexing and tooling power supply as well as start, stop and jog controls, indicator lights and provisions for automatic scanning devices. The panel permits adjustable timer controlled cycle or sequential operation of tooling and transfer movement. **Roller Gear Div., Ferguson Machine Corp.**, P.O. Box 5841, St. Louis 21, Mo.

Circle 404 on Inquiry Card

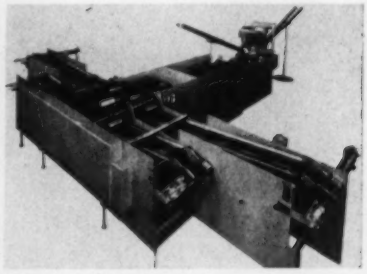


Center Drive Lathe

Designed for profile facing such pieces as turbojet engine disks of sizes ranging to 44 inches OD, center drive facing lathe features automatic cycling. The center drive unit is mounted front to back midway of the lathe bed in precision antifriction bearings and lubricated by means of oil mist. Both right and left hand carriages and slides couple with the center drive to provide an automatic cycle which includes traversing the entire diameter of the part, and is elastic enough to incorporate any action necessary to perform as an automatic cycle. Automatic 360-degree electric duplicator units are provided to the cutting tools on both sides of the center housing. Hydraulic duplicators are also available.

In operation, cutting tools mounted directly on opposite sides of the workpiece simultaneously turn both sides. Rough, semifinishing and finishing passes have been made on parts having a 22-inch diameter and a thickness of 0.029-inch. The spindle speed control for constant surface speed at any pick-off is achieved by a cam-controlled, variable speed drive unit. The feed motors are tied in with the drive and increase or decrease the speed according to the rpm. This automatic tie-in controls the chip thickness. All moving parts, bearing surfaces, bearings, etc. are provided with an automatic metered forced feed lubrication. Automatic chip disposal and loading devices for use on the machine are available. **Wickes Machine Tool Div., Wickes Corp.**, Saginaw, Mich.

Circle 405 on Inquiry Card



Cookie Packager

Cookies are sandwiched, counted, stacked, grouped and loaded automatically right off the oven at speeds of 1400 or more per minute in a continuous line operation. With this model GT double-row sandwiching machine, cookie sandwiches are automatically divided into four rows, counted, stacked, grouped and loaded into cellophane bags, cartons or trays.

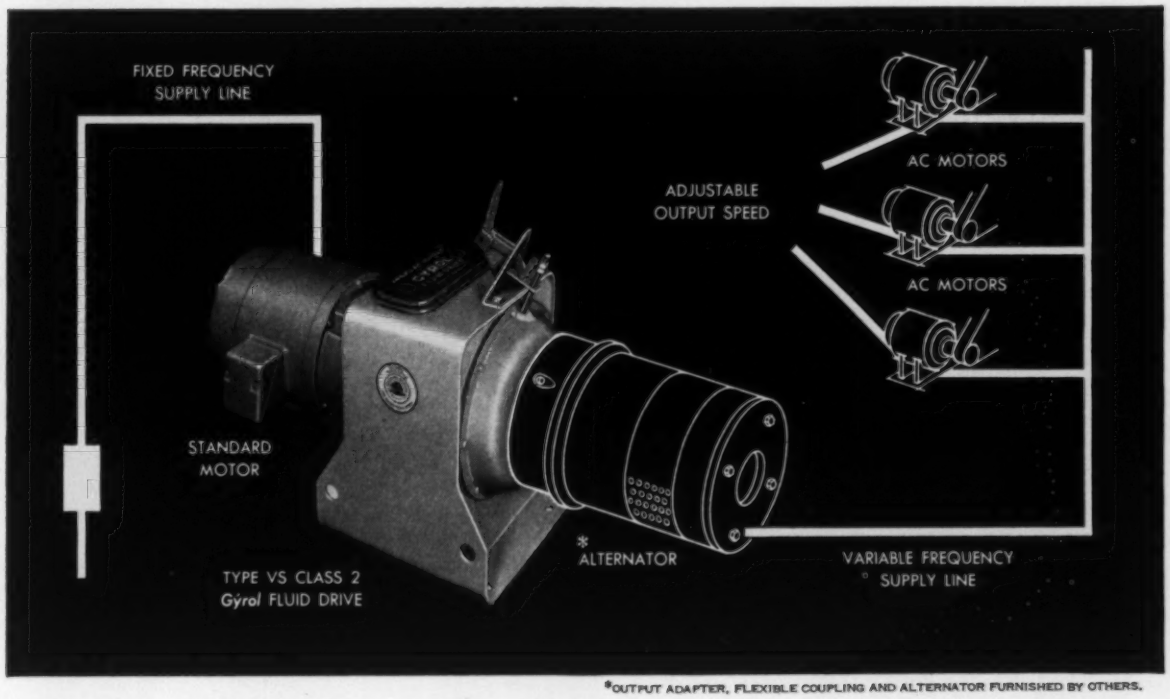
The sandwich packaging units can be co-ordinated by conveyors with Model L-2 cellophane bag sealing and header applying machines. They can also be co-ordinated by conveyors with wrapping machines for cartons or trays. The equipment can be used to handle plain cookies as well as cookie sandwiches. **Peters Machinery Co.**, 4700 N. Ravenswood Ave., Chicago 40, Ill.

Circle 406 on Inquiry Card

Transfer Leaf Printer

Used for automatic marking, dating or coding on polyethylene, pliofilm, cellophane, waxed paper, glassine, foil, tissue and similar materials that take hot roll leaf impression, transfer leaf printer is designated #S-90. The unit is designed for imprinting bags and wraps for bacon, fish, bakery prod-

Now—get matched, adjustable-speed control of AC squirrel-cage motors with American Blower *GÝROL*® Fluid Drives



*OUTPUT ADAPTER, FLEXIBLE COUPLING AND ALTERNATOR FURNISHED BY OTHERS.

A Gýrol Fluid Drive coupled to a standard alternator can vary the output speed of two or more AC motors. For example, a standard induction motor can operate at rated speed at 60 cycles, or half rated speed at 30 cycles, since speed for a given motor is proportional to frequency.

Here's a simple system for varying the output of two or more standard, constant-speed AC induction motors – simultaneously – to equalize load distribution, prevent costly machinery breakdowns.

An alternator, driven through an adjustable-speed Gýrol Fluid Drive, makes variable frequency available from a fixed-frequency power source. Since AC motors operate at speeds proportional to the frequency of applied power, motor speed is controlled by merely regulating the Gýrol Fluid Drive.

What's more, motors of different speeds or types can be used in the same system, and will change speeds proportionately; single-motor systems can also be set up. Control can be manual, semi-automatic, or automatic, and is adaptable to infrequent or frequent repeat cycling.

If you're looking for more dependable, lower cost adjustable-speed control of driven machinery, with fewer breakdowns, lower maintenance, why not look into a Gýrol Fluid Drive coupled to a standard alternator. Call our nearest branch office for full details. American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ont.

AMERICAN BLOWER

Division of AMERICAN-Standard

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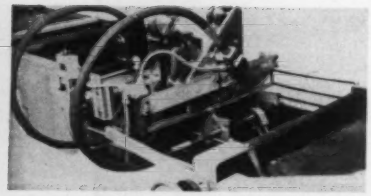
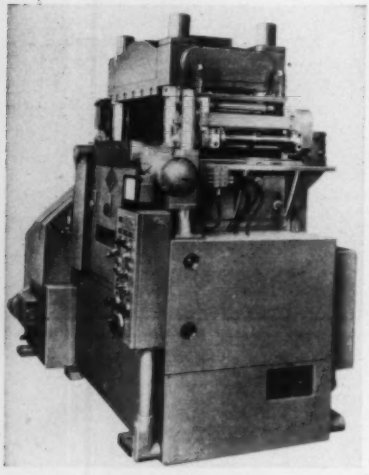


ucts, frozen goods and many other products using flexible wrapping materials.

Synchronized with and taking speed from the bag-making machines, the unit automatically and accurately spot prints in all combinations of colors, letters and numbers for either quality control or product identification. **Industrial Marking Equipment Co. Inc.,** 454 Baltic St., Brooklyn 17, N. Y.

Circle 407 on Inquiry Card



Automatic Stamping Press

Designed as a precision press, 75-ton, double crank direct drive unit handles long, unbalanced progressive dies without distortion. The press is 7 ft 5 inches high, with stroke and adjustment up. It requires only 68 by 95 inches of floor space; no pits are required. Press is operated at the shoulder level of the operator.

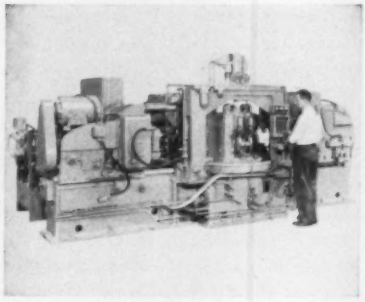
Overhead thrust on the head is eliminated because the underdrive mechanism in the base pulls the head down. The standard stroke is 2 inches; maximum stroke is 4 inches; rated capacity of the press is 150 standard strokes per minute. The four-post construction assures perfect alignment of both the punch and the die. The head rod guides are mounted in large bearings, from the bottom cross beam to the head.

A pneumatic clutch and brake for the press have been designed as a single synchronized unit. The air clutch is a combination flywheel type, air operated with multiple friction disks, and synchronized with the multiple disk brake. The unit is mounted on antifriction bearings. The clutch control provides for inching, single stroke, continuous operation and for forward and reverse operations. Air counterbalances offset the load of the heavy dies and the reciprocating parts. **Alpha Press & Machine Inc.,** 9281 Freeland Ave., Detroit 28, Mich.

Circle 408 on Inquiry Card

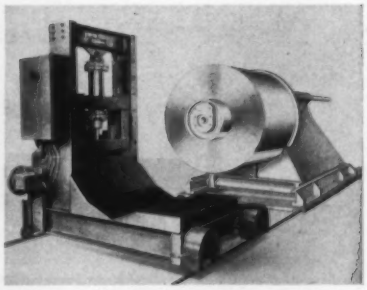
Machining Diesel Rods

Three-way, four-station horizontal automatic indexing machine produces 84 diesel connecting rods per hour at 100 per cent efficiency. Surfaces machined include wrist pin hole, crankshaft hole and bolt boss faces. Rod and cap are sawed apart in the last station of the machine. Fixtures are manually loaded with two connecting rods and are mounted on the index table located at the first station. The two rods are then automatically clamped into position by a built-in, air operated torque wrench. Premachined centers in each of the rods are used for endwise location in the fixture. The rods are then automatically indexed from station to station by a hydraulically operated gear and rack mechanism.



Machine features a hydraulic system for all stations, automatic lubrication and chip disposal. **Greenlee Bros & Co.,** 2136 12th St., Rockford, Ill.

Circle 409 on Inquiry Card



Heavy Duty Coil Car

Developed for loading coils onto pay-off reels and unloading coiling reels, heavy duty coil car features fast and safe operation. Coils are carried in a heavy steel cradle supported in a rigid L-shaped frame which is raised and lowered hydraulically. The cars are provided with through axles, roller bearings and flanged wheels; they operate on two rails set at floor level, eliminating the excavation, construction, drainage, maintenance and safety hazard of pits.

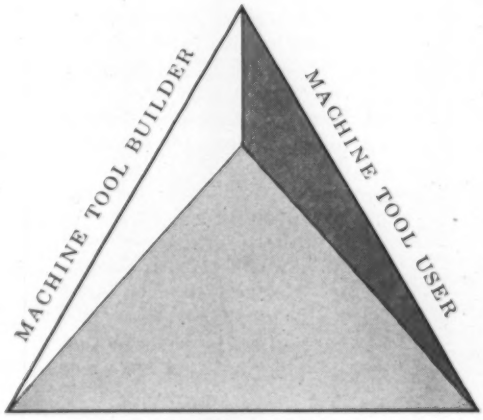
The car is loaded with a coil from a coil ramp, lift truck or crane, and is then moved across the tracks into position near the reel, to be ready to reload the reel as soon as the preceding coil is free. All controls and the hydraulic cylinder that raises and lowers the cradle are mounted in the vertical housing. Cars are furnished in three standard sizes. **Herr Equipment Corp.,** Warren, O.

Circle 410 on Inquiry Card

Grinder Measuring Gage

Developed for centerless grinding machines, continuous measuring gage is designated Series 493-CG. The device continuously measures the output of various type centerless grinders and visually indicates any trend toward out-of-tolerance work so that as many as three or four machines can be easily and adequately supervised by a single operator.

To permit the gage to respond to workpiece size only, ignoring local irregularities such as spaces between workpieces, oil holes, annular grooves, etc., the unit incorporates time delay response which is adjustable in accordance with the speed of work travel and piece length. Large lights on top of



THE AUTOMATION PYRAMID

The very essence of automatic metalworking and part transfer is CONTROL. And, for greatest effectiveness, control must be an integral part of the basic design of the system—not a belated afterthought.

Thus, the Automation Pyramid rises from a base that incorporates the concurrent efforts of the user, the machine tool builder and the "autometrologist"*. Each contributes essential knowledge and experience that is exclusively his.

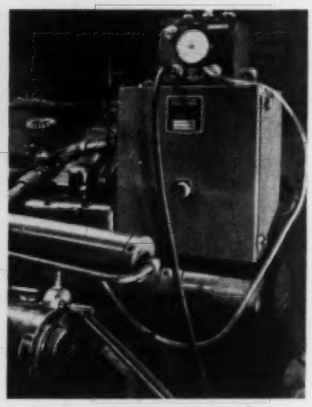
The user alone can define the task by specifying the design, quality and production rate of the product to be made.

The machine tool builder defines the sequences in metal removal, the speeds and feeds. The "autometrologist" is responsible for the choice and combination of sensing, measuring, prediction, feedback, machine control and assembly operations.

Before embarking on your automated project, take advantage of Sheffield's extensive experience in "Autometrology". It will save much valuable time and reduce operating cost. Write to the Sheffield Corporation, Dayton 1, Ohio, U.S.A., Dept. 3.

**AUTOMETROLOGY—The science of combining machining, motion or memory with automatic measuring.*

7709



the meter switch unit provide indication; the gage can also be equipped with audible signals.

The indicating dial is graduated in 0.00005-inch and the air-electric system used in the gage permits indicating limits to operate consistently within 0.000005 of their established settings. The gage is supplied with an air snap gaging head which can be equipped with various size spacing blocks to suit a variety of work sizes. It can also be equipped with an air ring gaging head, as illustrated. **Federal Products Corp.**, 1144 Eddy St., Providence 1, R. I.

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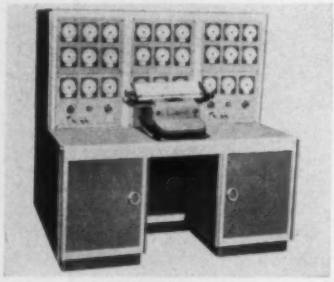

Simultaneous Data System

Designed for process manufacturing and aeronautical fields where an instantaneous sample of a large number of variables is required, miniaturized multichannel data system receives analog inputs from any number of primary sensing elements, and presents decimal digital data on all channels simultaneously. Each channel of data uses a Bristol miniature Dynamaster indicator with analog-to-digital converter in the original instrument housing. The indicators feature plug-in construction for interchangeability and ease of maintenance.

All channels can be balanced and digital data set up in 1 second. The decimal digital data directly operates any parallel entry printer, card or tape punch. Programming equipment is available to operate serial entry printers and electric typewriters. Twenty-seven simultaneously setup channels of data, programers, power supplies and one or more typewriters are easily mounted in the standard desk type console illustrated. **Hanson-Gorrill-Brian Inc.**, 85 Hazel St., Glen Cove, N. Y.

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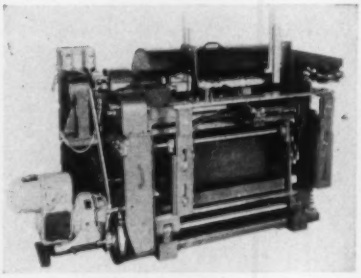


Wood Shaper & Turner

Round, square, octagonal, hexagonal or polygonal shapes of wood are automatically turned by shaping and turning lathe. Stock up to 24 inches long is quickly formed into table or chair legs, ten pins, pedestals, etc., with little secondary sanding required.

One operator can run three machines, turning out up to 1500 pieces per hour. Because both the head and tail stock drive the workpiece at controlled speeds, concentricity and accurate tolerances are afforded. Arrangement of cams attached to the work spindle revolving against a concentric faced shoe forms the square, octagonal, oval and all polygonal shapes. The action of the cam revolving against the shoe guides the carriage in and out according to the shape of the cam. Cam aligning mechanism is completely automatic. The drive end of the machine is equipped with a motor that permits change of speed from 60 to 500 pieces per hour by turning a lever while the machine is in operation. **I. H. Bradley & Sons**, 290 Fifth St., Bridgeport 7, Conn.

Circle 413 on Inquiry Card

Gaging & Feedback Unit

Multiple automatic gaging and feedback machine control are combined in the Multi-Feedbak device. The unit consists of a set of gage tooling and provisions for receiving and measuring precision parts from each of a series of machines. Individual parts are conveyed through the automatic gaging control system through a series of part handling devices. A memory system positions the incoming parts into gaging stations one at a time as they flow from the different machines.

Controls go into action as each part is being inspected. Electrical gage signals received from the part are transmitted to the particular machine that produced the part. These electrical signals, flashing on a small panel located at each machine, can then be used to stop or correct the machine if it begins producing a predetermined number of reject parts.

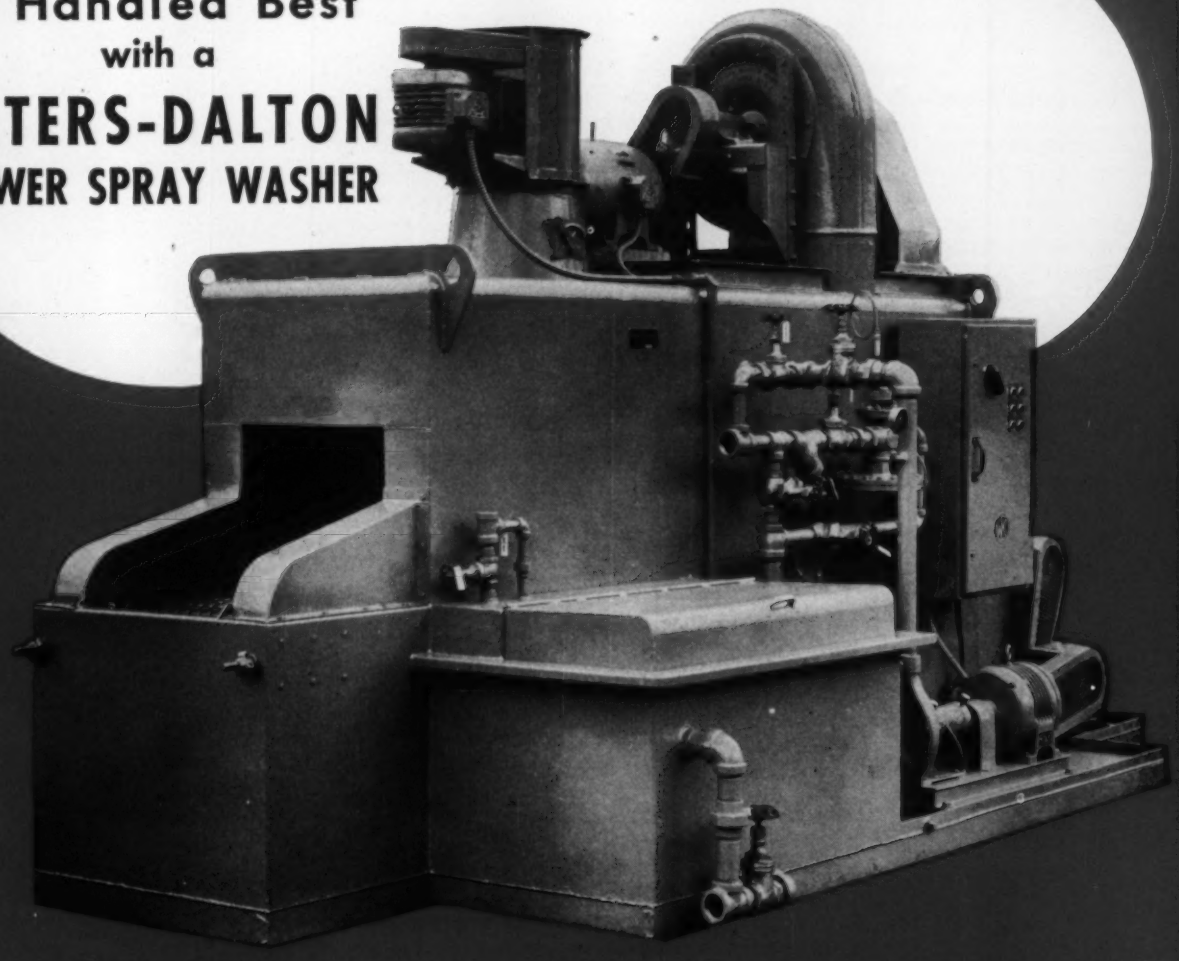
In cases where all parts passing through the gaging control unit are not quite the same, two gaging stations are incorporated into the device. In cases where basic dimensions may be same but overall sizes are different, a primary gage station inspects the basic dimensions and a series of secondary stations inspect the variable dimensions of the part. Here the memory system performs the additional job of determining which secondary gage station will inspect the part after it leaves the primary station. The memory system may also be used for segregating acceptable parts into individual lanes or chutes corresponding to the various types of parts to be produced. **Autometrology Div., Sheffield Corp.**, Dayton 1, O.

Circle 414 on Inquiry Card

Circle 578 on Inquiry Card→

NO GUESSWORK . . .

Between—Operation Cleaning or Paint Preparation Handled Best with a PETERS-DALTON POWER SPRAY WASHER



For more than a quarter century, PETERS-DALTON has been designing, engineering, building and installing Power Spray Washers to meet every industrial need. Tailor-made to the job they are built to perform, these P-D Power Spray Washers have proved their worth through long years of efficient production.

The illustration above is of a single stage steam heated P-D Power Spray Washer with high velocity blow-off. It was designed and built to clean miscellaneous small parts. Among its features are facilities built-in for cleaning the spray risers automatically with steam. This washer was delivered by P-D completely ready for operation.

Perhaps you have production needs that can be answered with a "tailor-made" machine such as the one shown here or requirements that call for installation and construction within your own plant. Regardless of your need or of its size, depend on PETERS-DALTON. Just write, wire or phone — we'll be glad to tell you more.

Representatives in principal cities.

- *Hydro-Whirl Paint Spray Booths*
- *Industrial Washing Equipment*
- *Drying and Baking Ovens*
- *Hydro-Whirl Dust Collecting Systems*

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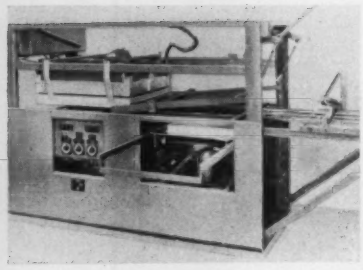
PD *Peters-Dalton* INC.

A SUBSIDIARY OF DETROIT HARVESTER CO.

17894 Ryan Road • Detroit 12, Michigan

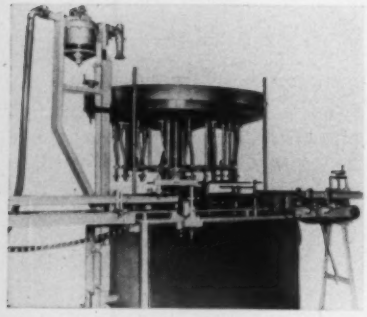


Vacuum Forming

Available for multistation feeding, completely automatic operation, and in various platen sizes, vacuum forming machine features high production rates from a continuous roll fed operation. Illustrated model is for single-station feeding and semiautomatic operation, with a platen size of 20 by 25 inches.

Used for skin packing, blister packing and visual packaging process called Snap-Pak, the machine is equally useful for high rate production of items up to 5 inches high, from thermoplastic sheets ranging from 0.002 to 0.125-inch thickness. Visual packaging has been applied to such items as food, cosmetics, drug items, toiletries, hardware, etc. **Auto-Vac Co.,** 1985 State St. Ext., Bridgeport, Conn.

Circle 415 on Inquiry Card

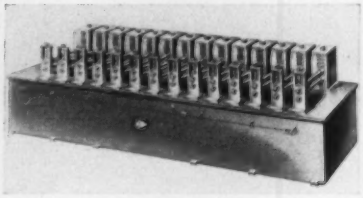


Automatic Metered Filler

Precise amounts of such materials as olive oil and motor oil are placed in containers by automatic metered filling machine. The machine is a fully automatic unit operating in the continuous rotary principle with 16 spouts capable of filling up to 60 containers a minute. A meter is mounted above the machine connected to a main supply tank. The meter draws the exact amount of liquid from a supply tank and deposits the material to the 16 receptacles mounted into the upper section of the machine.

Each of the receptacles is individually connected to a filling nozzle. As the container moves into the rotary section of the machine and comes in contact with a nozzle, it automatically trips open the nozzle permitting the material to drop into the container. The illustrated meter handles 25 gal of material and can be used for filling gallon, ½-gallon and quart containers. The meter can be supplied to handle greater volume of materials for pint and ½-pint containers. **MRM Co. Inc.,** 191 Berry St., Brooklyn 11, N. Y.

Circle 416 on Inquiry Card



Rolling Mill

Interchangeable arbors are a feature of metal forming rolling mills. By removing the outboard and taking out two screws on each arbor, the arbor can be changed to one of the right size to provide the correct rigidity for the form to be rolled. Sizes vary from 1 up to 3 inches.

Approximately 140 minutes are required to remove arbors for a 14-head rolling mill. Another feature of the mill is the variable speed drive and electric control which travels the strip steel at the proper speed for quality forming and maximum production. Each mill is powered by a three-phase electric motor which transmits the driving force through the magnetic clutch and brake and then to the gear boxes, each of which is equipped with herringbone gears. From there the motivating power is transmitted to the station, with each arbor operated by a spiral worm gear which in turn operates a bevel gear. **Mohawk Metal Forming & Tool Corp.,** 1330 Industrial Ave., Dearborn, Mich.

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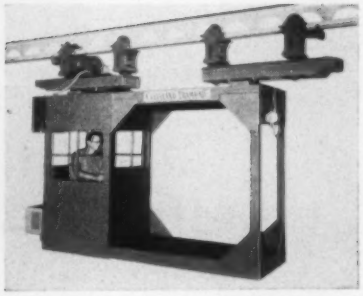
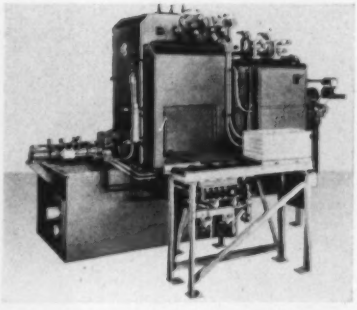


Air Conditioned Carrier

Designed especially for conveying ladles of hot metal used for die casting, air conditioned carrier for overhead tramrail systems can be changed in size and adapted for other materials handling purposes. Illustrated carrier has a cab which is enclosed with aluminum paneling and is provided with air conditioning to keep the operator cool while transporting molten metal. The door has a safety switch that prevents the carrier from being moved when the door is open. Unit has a capacity of 3100 lb and travels at speeds up to 300 fpm. Carriers of other capacities and speeds are available. **Cleveland Tramrail Div., Cleveland Crane & Engineering Co.,** Wickliffe, O.

Circle 418 on Inquiry Card



Automatic Batch Furnace

New unit in a line of automated, controlled atmosphere, batch-type furnaces automatically preconditions, loads and unloads the work chamber and quenches the processed charge. The furnace features pressurized operation, a double elevator and automatic transfer mechanisms. In operation, when there is a load in the work chamber and a preconditioned load on the upper elevator,

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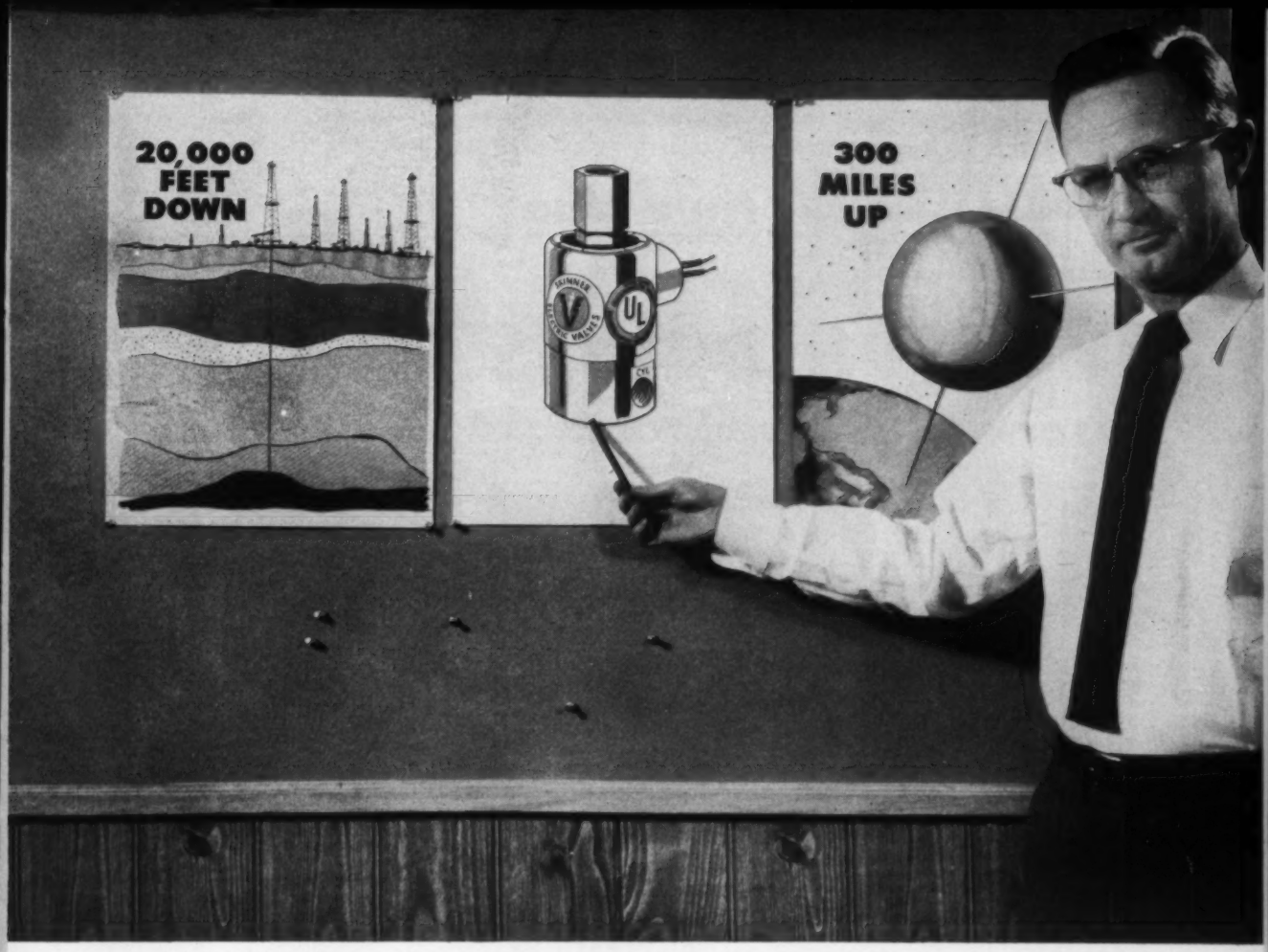

The versatile design of Skinner Solenoid Valves makes their applications almost unlimited

Skinner Solenoid Valves have such great versatility that no one, not even their makers, knows the full extent of their applications. The range of their extremes demonstrates this vividly. One Skinner valve is being used in an instrument in Texas oil wells that tells the nature of earth strata 20,000 feet below the surface. Another one will be used to help launch the satellite that soon will be circling the globe.

If you have a problem that a solenoid valve might conceivably solve, we urge you to talk to a Skinner representative. Fill him in on the nature of your application. He'll be glad to work with you in selecting a valve that matches your requirements as to port sizes and locations, voltages, pressures, temperature conditions, flow adjustments and mountings.

For complete information on Skinner's line of 2-, 3- and 4-way valves, write us or contact a Skinner representative. Write Dept. 324.

Skinner Solenoid Valves are distributed nationally

SKINNER ELECTRIC VALVES

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SKINNER ELECTRIC VALVE DIVISION

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SMALLER
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A New Line
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FERGUSON DRIVES
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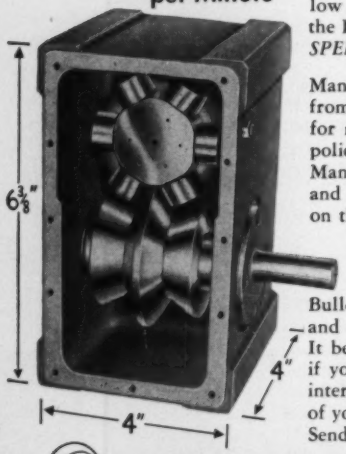
Ferguson Drive on gum wrapping machine replaced geneva drive and increased production more than 25% while drastically reducing maintenance requirements of the machine.

HIGH SPEED INDEXING

For O.E.M. Applications with High Speed, Low Torque Requirements . . . up to 2,000 Indexes per Minute

The Ferguson Drive, the ultimate in high speed, precision indexing for mass production, is now available in smaller sizes with lower prices for inclusion in instruments and machinery having low torque requirements and the need for doubling *or even tripling* operating speeds. The new "E" Series offers all the advantages of precision, low maintenance and design versatility for which the Ferguson Drive is famous, *PLUS OPERATING SPEEDS UP TO 2,000 INDEXES A MINUTE!*



Manufactured in quantities and delivered from stock, "E" Series Drives are priced for multiple unit orders. Our special discount policy enables qualified Original Equipment Manufacturers to order a single Drive for testing and earn a generous discount on the basis of a later quantity order.

SEND FOR BULLETIN NO. 107A

Bulletin 107A contains dimensions and load ratings of the "E" Series line. It belongs in your file if you are an O.E.M. engineer interested in improving the rated capacity of your equipment employing intermittent motion. Send for your copy now!

HIGH SPEED INDEXING • STANDARD TRANSFER MACHINES • AUTOMATIC TOOLING

ferguson

FERGUSON MACHINE CORPORATION OF INDIANA

Roller Gear Division, Dept. A-4 • P.O. Box 5841, St. Louis 21, Mo.

the process is as follows: At the end of the time interval for the load in the furnace, the inner door raises and the work is automatically placed on the double elevator. The elevator descends, quenching the work load and moving the preconditioned load into position in front of the inner door. As soon as the elevator is down, the preconditioned charge moves into the work chamber and the inner door closes. The second stage in the process occurs when the quenching cycle is completed. The outer door automatically opens allowing a "green" charge to move onto the upper elevator; the elevator then raises. This moves the green charge into preconditioned position. The quenched work is automatically moved out onto the conveyor, the vestibule is automatically purged, and the outer door automatically closed. The new furnace has a gross heating rate of 800 lb per hour, temperature range of 1450 to 1700F, and an oil quenching system for carburizing, carbonitriding, carbon restoration and clean hardening. **Dow Furnace Co.**, 12045 Woodbine Ave. Detroit 39, Mich.

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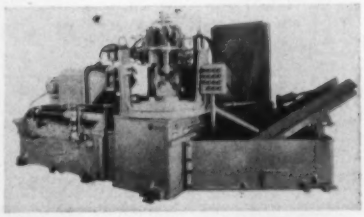

Two-Way Index Machine

Both ends of a steel elbow are faced and chamfered simultaneously by horizontal two-way index machine. When the elbow leaves the machine, it is ready for welding. An electric powered index table has two positions. For greater rigidity, heads target into the fixture. Single-point carbide tools are mounted on sliding catheads which pilot from the inside diameter of the elbow.

Operation is automatic, with the operator simply loading and unloading one station. Production at 100 per cent efficiency is 146 per hour on 1-inch elbows and 27 per

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EARLY TELETYPEWRITER

TELETYPE MODEL 28 PRINTER

50 years that changed the picture

The need for a reliable printing telegraph instrument that would provide a typed record of the message for both sender and receiver brought the company now known as the Teletype Corporation into the picture in 1907. From the halting performance of the original page printer to the smooth 100 words per minute of today's precision equipment has been a major step in communications.

But today Teletype equipment is often far more than a communication instrument. It is a basic element in production control systems . . . its ability to transmit and reproduce text and punched tape is harnessed to office automation . . . it provides a "conveyor system" for channeling complex raw data to a computing center thousands of miles away — and getting the answers back in a twinkling.

Indeed, Teletype machines have made many of the dreams of 1907 a daily part of today's business world. And the horizons widen daily as new dreams occupy our engineers and keep our laboratories humming.

If you would like a copy of our booklet, "The ABC's of Teletype Equipment," write to Teletype Corporation, Dept. AV-4, 4100 Fullerton Ave., Chicago 39, Illinois.

1957 Golden Anniversary Year

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On which of these can you use help?	OK here	Can use help
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PRODUCTION PROCESSING		
TOOL & DIE DESIGN		
MACHINE DESIGN		
TIME STUDIES AND ANALYSIS		
AUTOMATION DEVELOPMENT		
PLANT LAYOUT & SPECIFICATIONS		
PRODUCTION & QUALITY CONTROL		

Handy Check List for Executives and Chief Engineers

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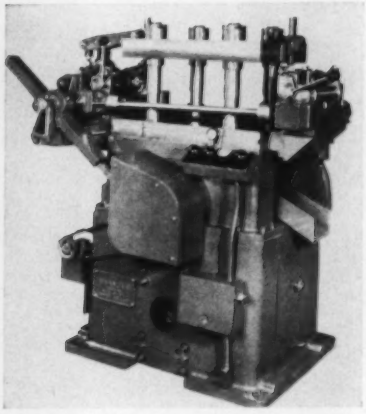
BRANCH OFFICES IN DAYTON, OHIO, WASHINGTON, D. C. and TORONTO, ONT., CAN.

hour on 4-inch size. Speed changes for different size elbows are accomplished quickly by pick-off gears on the drive bracket. Fixture jaws are replaceable for different diameter elbows. The machine is composed of standard components that can be adapted to other uses such as boring, drilling and tapping. **Baker Brothers Inc.**, Toledo 10, O.

Circle 420 on Inquiry Card



High Speed Press

Well suited for use in blanking large quantities of small parts, 30-ton automatic press operates at speeds up to 500 strokes per minute. The high speed is made possible by a combination of features, including air counterbalance, counterbalanced crankshaft, and low center of gravity. Draw rods are guided above and below the crankshaft. A coil feed mechanism provides greater accuracy at high speeds.

The press is 64 inches high, with a standard die area of 10 by 31 inches. Unit is available in a double throw model with a die area of 30 by 31 inches. **Brandes Press Co.**, 6408 Euclid Ave., Cleveland 3, O.

Circle 421 on Inquiry Card

Weight Data System

Weights are originated, transmitted and computed for remote recording by weight data system. In the illustrated industrial shipping and billing operation, the system performs three accounting jobs. First, the scale determines the gross shipping weight and transmits it in digital form to the

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IBM *announces a*

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For Scientific and Engineering Men

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We want men with creative ingenuity to solve problems *never encountered before* . . . who will significantly influence the new Division by their enterprise. Projects are not routine . . . and small enough to permit individual contributions that will establish your stature as a professional engineer.

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Career opportunities exist not only for electronic and mechanical engineers but also physical and chemical scientists and metallurgists with experience in any of the following areas:

- **analog or digital computers**
- **telemetering**
- **servo systems**
- **process control**
- **electronic packaging**
- **design of intricate mechanisms**
- **data conversion, transmission, processing or display systems**
- **instrumentation**
- **advanced component design**
- **automation**
- **solid state devices and applications**

Graduating E.E.'s, M.E.'s, physicists and mathematicians will find responsible, stimulating assignments in this Division.

PURPOSE OF THE DIVISION

The new Special Engineering Products Division has been created to enable IBM to apply systems knowledge, engineering and production skills to organizations seeking assistance on specific problems connected with the processing of industrial, commercial and scientific data. Its engineers will design, fabricate and install tailor-made systems for such applications as engine test stands . . . wind tunnels . . . flight test . . . industrial process control . . . machine tool and material handling control . . . nuclear reactors . . . innumerable others.

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It should be emphasized that the new Division has the responsibility for developing and building equipment related to, *but outside of*, IBM's regular line of products. The variety and diversification of projects call for ultimate creativeness to *develop nonstandard* computing and data-handling components, machines and systems for tie-in with existing IBM equipment.

FOR COMPLETE DETAILS, write today to R. A. Whitehorne, International Business Machines Corporation, Dept. 9704, 590 Madison Avenue, New York 22, N. Y.

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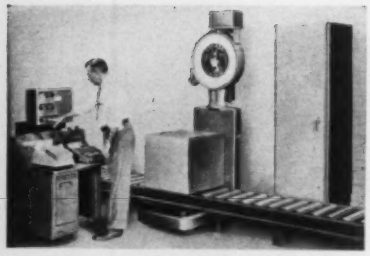

tabulator card punch. Secondly, the electronic computer automatically subtracts the tare from this gross weight to obtain net weight and multiplies this result by a factor to secure the final billing figure. This figure is automatically transmitted to the card punch. Finally, the factored weight is transmitted to an electric listing and adding unit as a production record.

The unit is equipped with a direct digital scanner which transforms the weight indications of the dial into a digital signal that may be recorded on any of several office machines: Card punch, tape punch, electric adding machine, electric typewriter or other recording device. **Custom Sales Dept., Toledo Scale Co.,** Toledo 1, O.

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GEM-17 DIAL INDEX TABLE

TRUE GENEVA MOTION

FOR FAST, *ACCURATE* AUTOMATION OF ASSEMBLY *and* MACHINING OPERATIONS

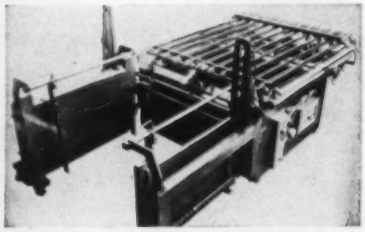
This new, high precision index table is accurate to plus or minus 0.001 in. on a 13 in. dia. work circle; can position work in as little as ½ sec.; indexes a 1,000 lb. fixture load.

BASIC SPECIFICATIONS: Standard Number of Stations—6, 8 or 12; 3 and 4 skip. Motor—Rotary air, fluid, or electric. Dial Plate—17 in. dia. standard; larger plates available. Rotation—Either direction. Interlock—Limit switch operated directly off locking bolt. Weight—200 lbs.

Gray engineers will help you adapt GEM-17 to your use. For recommendations, send specifications of your application. Illustrated brochure GE-21 and prices on request.

GRAY EQUIPMENT COMPANY

13600 Ford Road • Dearborn, Michigan • Telephone: Tiffany 6-7573



Shear Feeder & Stacker

Developed for use with square shears, Shear-Matic feeder and stacker is easily installed on existing equipment with an electrical interconnection. The desired length of cut is attained by adjusting the calibrated measuring device. Machine is ready for operation after the adjustable stacking mechanism is set.

In use, the operator starts the sheet through the shear and makes a squaring cut if desired. He then slides the sheet approximately 4 inches through the shear, and the pinch rolls on the Shear-Matic engage the sheet, pulling it automatically into the stops, which automatically cycle the shear. The sheet is carried away and automatically stacked as soon as the cut is made. **Die & Automation Inc.,** 1490 Edison Ave., Hamilton, O.

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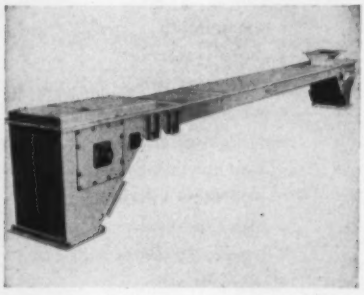


Belt Conveyor

Suitable for conveying materials over horizontal distances up to 300 ft, slider board belt conveyor can be used under bins and other types of material containers, and is often used as an inspection table providing an efficient method of con-

THE *FORWARD* LOOK INCLUDES CYPAK

. . . to provide automatic conveyor control at the new Plymouth assembly plant

Seven CYPAK* static control systems control the scheduling of auto bodies into storage conveyors at Chrysler Corporation's new assembly plant at Newark, Delaware.

In one CYPAK system, for example, the operator can select any of 15 storage lines by just pressing a button. A similar CYPAK system unloads the bodies, in pre-selected order, again through the use of just a pushbutton.

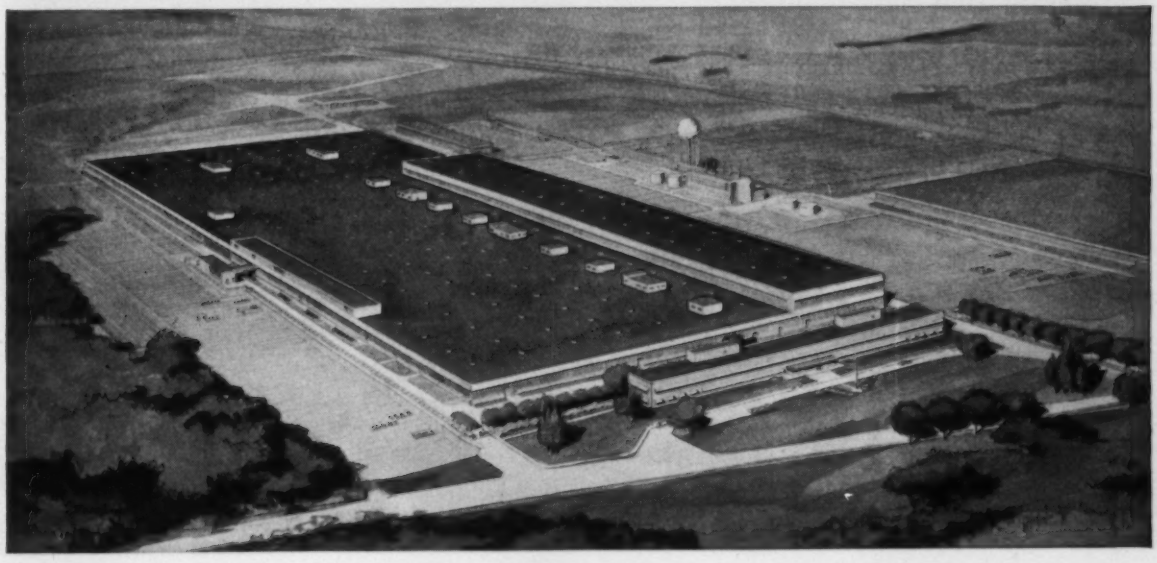
CYPAK was chosen because of its elimination of maintenance, economical operation, and reduced space requirements.

For complete information on CYPAK call your Westinghouse representative, or write Westinghouse Electric Corp., Dept. B, P. O. Box 868, Pittsburgh 30, Pa. *Trade Mark

J-22002

YOU CAN BE **SURE**...IF IT'S

Westinghouse



Circle 585 on Inquiry Card

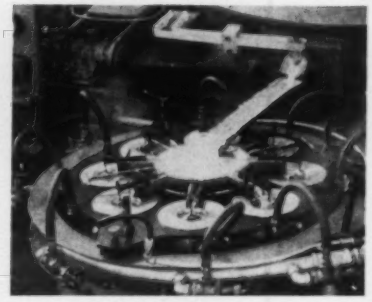
veying the products over a desired distance while permitting inspectors to safely remove defective material by hand. The conveyor is available in two standard sizes, 16 and 20 inches wide. The unit will handle almost any type of material which does not contain large lumps; it is particularly desirable for handling fragile materials.

The conveyor consists of an endless belt operating on a smooth sheet metal trough located between the head and the foot pulley terminals. The belt can be constructed of any material required to fit a particular application. The slider board is enclosed between skirt plates extending the full length of the conveyor to confine the material and to provide the necessary depth for the desired capacity or to accommodate lumpy and slightly abrasive material. **Sprout, Waldron & Co.**, Muncy, Pa.

Circle 424 on Inquiry Card

Automatic Caster

Developed for production of nonferrous billets and slabs, continuous casting machine handles both



heavy and light metals. The machine is used in casting a variety of shapes ranging from round extrusion billets—solid as well as hollow—to rectangular rolling mill cakes and slabs. The machine is capable of producing billet sizes from 3 to 20 inches in diameter and larger, and simultaneous casting of as many as 20 strands.

The automatic casting equipment can be arranged for either continuous or semicontinuous operation. The semicontinuous machines can produce multiple strands up to 25 ft long. The machines can handle practically all nonferrous metals and alloys, including aluminum, copper, nickel, zinc and their alloys. Quality control feature of the machine allows the grain size of the cast material to be controlled by regulating the speed of casting and the hot metal temperature. **Lobeck Casting Processes Inc.**, 114 E. 32nd St., New York 16, N. Y.

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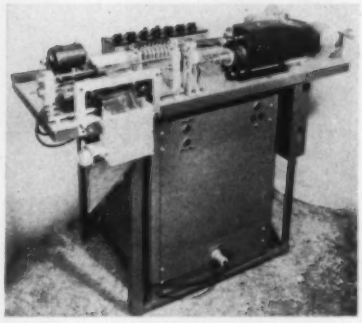

Resistor Production

Line of automatic resistor production equipment was developed especially for metal film and carbon deposited precision resistors. The sorting equipment in the line segregates the resistors after

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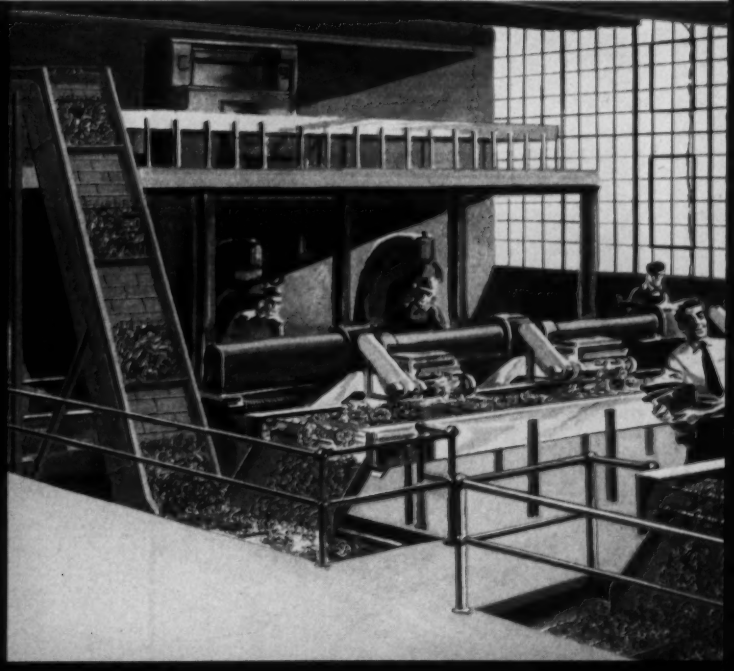

NOW...

coating. With an accuracy of better than ±0.5 per cent, the equipment is fully automatic and sorts resistors without leads into eight resistance categories at a speed of 3600 pieces per hour. The unit is also available for handling components with leads attached.

An automatic spiraling lathe, illustrated, is magazine fed and electronically controlled. It stops its spiraling function when a preset resistance value is attained. This unit is also available for spiraling resistors with or without leads attached.

A third type of equipment in the line is a high speed dc limit bridge for final testing of completed resistors. Accurate to better than ±0.1 per cent over a range of from 100 ohms to 10 megohms, the equipment is applicable with the same accuracy, to lower values when setup arrangements have been made to balance out zero resistance in bridge and contact circuits. Operating speed is 5000 pieces per hour, and the equipment is supplied with semiautomatic feeder and storage facilities to enable one operator to attend a number of machines. Also available is an adjusting machine for bringing components into final tolerance, where required. **Industrial Instruments Inc.**, 89 Commerce Rd., Cedar Grove, N. J.

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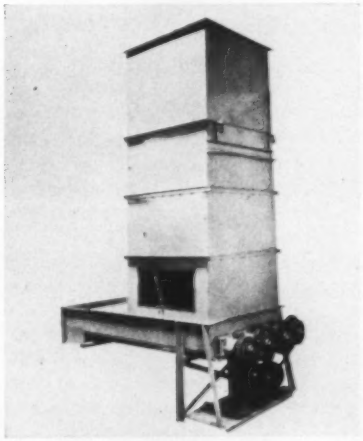

Weigh Hopper

Accurate weighing and thorough discharge of fluffy or sticky materials is provided by bell-shaped weigh hopper with motor driven screw discharge mechanism. The weigh hopper is designed for such materials as long asbestos fibers, rubber crumbs and similar non-free-flowing materials. The unit has three bell-shaped sides and one straight side, permitting unrestricted flow of material.

A variable pitch screw feeder provides live bottom discharge from the hopper. The weigh hopper is fully enclosed for dustproof operation, with operating levers outside the weighing chamber. It is suspended from a set of beams and terminates in a dial head. The hopper can be fed from a bucket elevator, screw feeders or other conveyors. The device can be discharged automatically with a mercury magnetic cutoff, or manually by pushbutton.

Optional equipment available includes: Automatic printer for recording full and empty balance of each weighing, remote indicating equipment, and automatic totalizing counters. **Richardson Scale Co.**, Van Houten Ave., Clifton, N. J.

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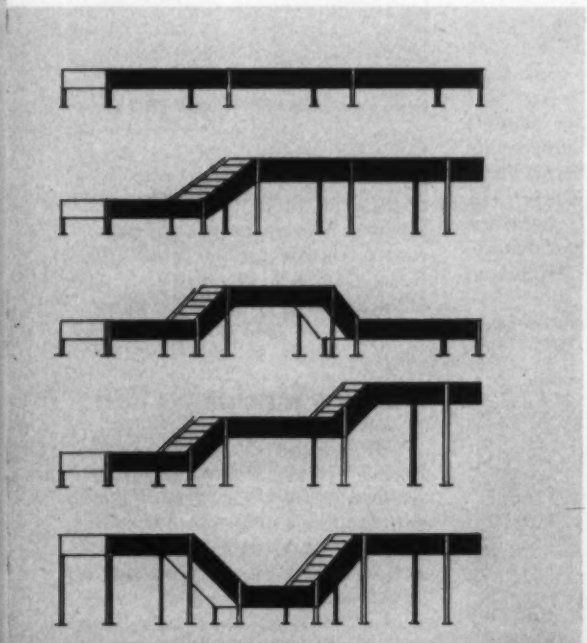


Here is a conveyor program designed for the unusual. NOW . . . you can have a customized conveyor today to meet production needs . . . and with modification, that same conveyor will meet the needs of tomorrow.

The May-Fran conveyor standardization program provides the standard components that can be assembled to form a special or standard conveyor. These same components can be re-arranged at any time to solve production problems in the future.

In addition, standard components mass produced mean conveyor economy right from the beginning.

Here is a conveyor program of standardization program that saves you money now . . . and in the future!

Write today for your copy of Bulletin MF-200

7321-MF

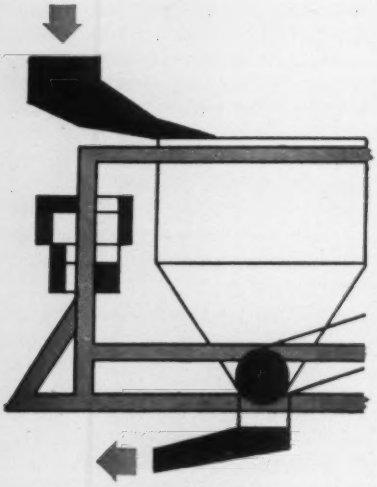
and in the FUTURE!

MAY-FRAN ENGINEERING, INC.
1761 Clarkstone Rd., Cleveland 12, O.

Circle 586 on Inquiry Card

UNITIZED WEIGHING

provides automatic batching



For sequence or continuous automatic batch feeding, W-C offers pre-engineered, "building-block" systems to meet virtually all requirements.

- **Batch-in or batch-out**
- **Solids and liquids**
- **Single or multiple materials**
- **Ratio batch and proportioning**

In a full range of sizes, you have your choice of weigh hoppers, feeders, weight transmitters, scales . . . semi-automatic or fully automatic controls, either "on-the-spot" or remotely located. You also have your choice of electric or pneumatic operation plus the overall flexibility and economy that only W-C UNITIZED WEIGHING Systems offer in fulfilling present *and future* weight batching requirements.

Write for descriptive literature.

W-C

WEIGHING & CONTROL COMPONENTS, Inc.

206-C LINCOLN AVENUE, HATBORO, PA.

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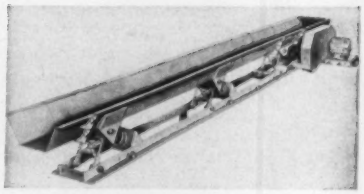

Oscillating Conveyors

Engineered for applications in the intermediate ranges and capacities, addition to oscillating conveyor line is called Coilmount. Conveyors handle a variety of materials including bottles, abrasives, metallic concentrates, chips and turnings.

Motion is imparted to material carried in the trough by means of a constant stroke eccentric drive that produces an upward and forward oscillating movement resulting in a gentle, continuous forwarding of materials regardless of overloads or surges. The trough is supported by cast aluminum rocker legs and coil springs. Units are available in fully assembled sections of 5 to 10-ft lengths, in trough widths of 10 and 20 inches, in 10-gage or 3/16-inch trough thickness. Sections can be assembled in lengths up to 100 ft.

Divider plates can be installed in the trough to convey more than one material simultaneously, and discharge of materials is possible at any point. Auxiliary components are available for screening, cooling, heating, drying, elevating, etc. Drives may be placed anywhere along the entire conveyor length. **Link-Belt Co.**, Dept. PR, Prudential Plaza, Chicago 1, Ill.

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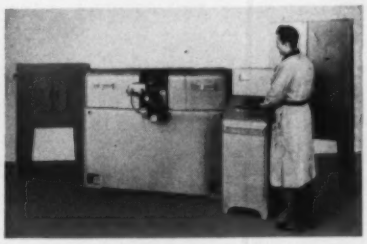


Gear Sound Inspector

Fully automatic loading, separate control console and noise safeguards are features of Model GSR electronic gear sound inspection unit. The device has a built-in electronic ear that automatically inspects and rejects gears based on operating sound levels. The unit can be adapted to electronically sound test gears in the 7/8 to 3-inch diameter range. Special tooling is provided for handling different gears.

The tested gear and its test mate are rigidly mounted on arbors supported from both sides, stub arbor designs being avoided because of possible resulting deflection conditions. Time delay controls in the electronic amplifier circuit require that any noise signal must last for a predetermined time before the gear rejection gate solenoid is opened.

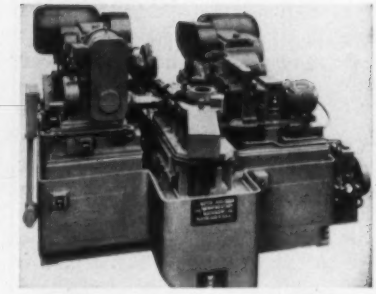
Gears are automatically loaded, run in both directions in mesh with another gear with and without brake loading, unloaded, and passed or rejected by the electronic sound discriminator unit whose microphone is placed near the gear mesh area. The sound discriminator unit may be adjusted at any time to the range of audible noise frequency and intensity desired for rejection. Pinions can be fed to the automated speeder unit from a conveyor unit or loaded manually into a magazine feed on the machine. Pushbutton controls are included for each machine function to facilitate setup operations. Air cylinders control the work arbor, loader and brake functions. Since the machine must operate at minimum sound levels, separate electrical and pneumatic control panels are included. **National Broach & Machine Co.**, 5600 St. Jean Ave., Detroit 13, Mich.

Circle 429 on Inquiry Card

Multiple Machining Unit

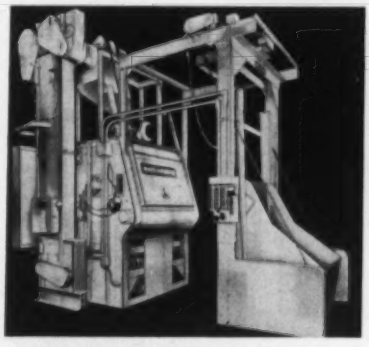
Simultaneous milling of two surfaces, drilling, rough boring and reaming are performed on 27 parts per hour by multiple machining unit. The machine is used to process farm equipment transmission housings.

In operation, the table rapid traverses to the rear and then feeds past two opposed milling heads. After milling on return, three holes are drilled on one side and the cored opening at the neck of the case is rough bored on the opposite side simultaneously. The table ad-



vances to the third and final station where three holes are reamed by the same six-spindle head used in drilling the three holes. Operations between load and unload are automatic. All clamping, movements and feeds are hydraulically controlled. The end of the machine where the operator loads the part in the fixture is illustrated. **Machinery Mfg. Div., Motch & Merryweather Machinery Co.**, 888 E. 70th St., Cleveland 3, O.

Circle 430 on Inquiry Card



Abrasive Blast Cleaner

Designed to provide reliable performance required for automatic operation, airless abrasive blast cleaning machine is readily converted to automation because of its standard power features. A single pushbutton actuates the entire sequence from loading to unloading, without the observation of an operator. The machine, which cleans sand, scale, oxides and other contaminants from metals, is a batch-type unit for work that can withstand a tumbling action. It has an operating load capacity of 14 cu ft.

Faster cleaning is provided by hurling of a large volume of abrasive upon the work. An abrasive hurling wheel throws 830 lb of abrasive per minute. The machine

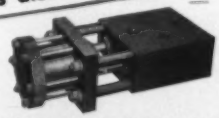
INEXPENSIVE—HIGHLY EFFICIENT

UNEQUALED FOR ⅛" AND ¼" SERVICE

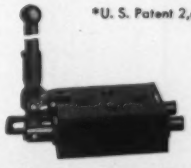
• These valves combine utmost simplicity, low price and rugged, efficient, dependable construction. Valve chambers* are formed by aluminum spacers held tightly in metal to metal end abutment assuring accurate positioning of the "O" rings on both inside and outside diameters without mechanical pressure. The flow is from the inlet chamber through the hollow radially ported ground and polished stainless steel plunger, and out through other ports in the plunger to the connected line. No direct impingement of flow across the packings. No lapped joints. No metal to metal seating. Sub-base permits ⅛" or ¼" pipe connections into either side or bottom. Easily serviced in the field. Write for fully descriptive bulletin.

*U. S. Patent 2,645,450

Ask us also about . . .



PILOT CYLINDER OPERATED HYDRAULIC VALVES suited for use with water or hydraulic oils up to 5,000 psi. 2-way, 3-way and 4-way actions. Sizes ½" through 4".



LEVER OPERATED HYDRAULIC VALVES suited for use with water or hydraulic oils up to 5,000 psi. 2-way, 3-way and 4-way actions. Sizes ½" through 1½".

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AIR AND HYDRAULIC
Control Valves

Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated

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If you are not ready for the plunge into automation . . . we can furnish special holding fixtures for your standard machines that will help match the efficiency and production capacities of automated equipment. Send your prints. No obligation, of course.

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DAYTON 4, OHIO, U.S.A.

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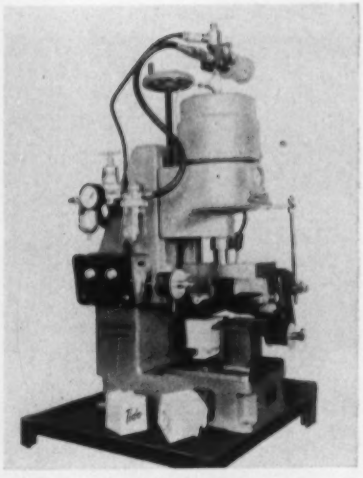
is available with either of two separators—one with high efficiency for foundry applications, the other for less exacting requirements. The high efficiency separator assures that every pellet thrown by the wheel is effective metal shot or grit and that the optimum abrasive mixture is maintained throughout the blast cycle. It is mounted at the bottom of the machine for easy servicing. The Super Tumblast machine features a tight steel flight conveyor so that there are no areas where work can jam and displace liners, interfere with the operation of the door or break the abrasive tight seal on the machine. The power operated door is sealed and rigidly reinforced to keep abrasive from escaping the machine. It withstands impacts from both inside and outside. **Wheelabrator Corp.**, Mishawaka, Ind.

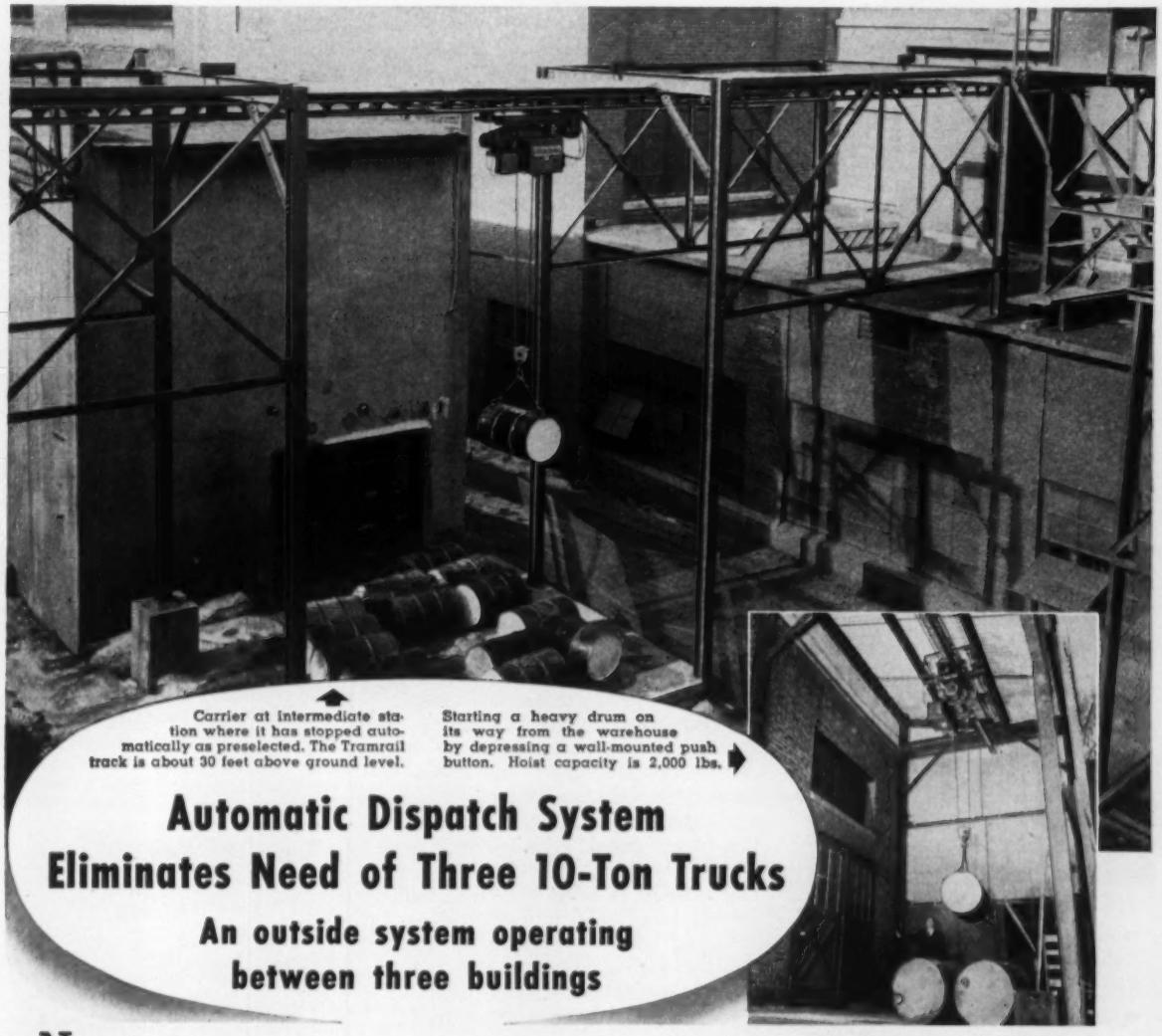
Circle 431 on Inquiry Card



Hot Stamping Press

Up to 4000 pieces per hour can be stamped by hot stamping press with automatic feed. The unit is designated as Acroleaf Model 250-H and has a die area of 6 by 6 inches, takes roll leaf up to 6 inches wide, and has a 9½-inch high adjustable die space with an 8-inch depth of thrust.

Press is equipped with automatic controls to regulate the temperature of the heated head, the marking pressure, the dwell and the foil advance. It may be preset by the operator to meet individual job requirements. Sufficient rigid-



Carrier at intermediate station where it has stopped automatically as preselected. The Tramrail track is about 30 feet above ground level.

Starting a heavy drum on its way from the warehouse by depressing a wall-mounted push button. Hoist capacity is 2,000 lbs.

Automatic Dispatch System Eliminates Need of Three 10-Ton Trucks

An outside system operating between three buildings

Not only was the need of two 10-ton trucks obviated by a Cleveland Tramrail automatic system at the Mica Insulator Company, Schenectady, N. Y., but the purchase of a third truck was made unnecessary. While the trucks had to travel over a circuitous route, only a short, straight Tramrail track is required for the overhead system.

Many man-hours of trucking and handling time are saved because materials dispatched over the automatic Tramrail system can be handled by production workers along with their regular jobs. A great amount of handling on an elevator has also been eliminated and better elevator service is available for other purposes.

The system has been found particularly helpful during night shifts when an extra drum of varnish or roll of cloth is sometimes needed. Formerly trucks were never available for night hauling. The Tramrail equipment paid for itself out of savings it created in a short period.

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THE CLEVELAND CRANE & ENGINEERING CO.
1365 East 284th Street, Wickliffe, Ohio.

CLEVELAND TRAMRAIL
OVERHEAD MATERIALS HANDLING EQUIPMENT

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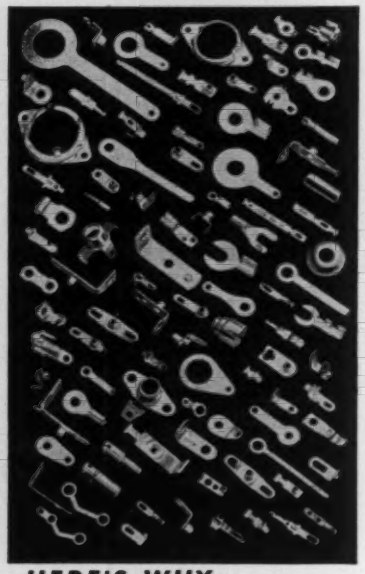
FOR
SOLDERING LUGS
TERMINALS
PRINTED CIRCUIT
HARDWARE



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Request handy reference catalog containing specifications on standard and custom-made lugs, terminals, corona rings, pins, contacts and similar stampings.

Malco TOOL and MANUFACTURING CO.
4017 W. Lake St., Chicago 24, Ill.

Circle 591 on Inquiry Card

ity and power are provided to stamp most thermosetting materials, as well as plastics, fiber, wood, paper and coated metals. Automatic feeders on the press increase production by as much as 300 per cent. The unit requires connection to a standard 75 to 150 psi air line, and to a 110-120v electric line. **Acromark Co.,** 492 Morrell St., Elizabeth, N. J.

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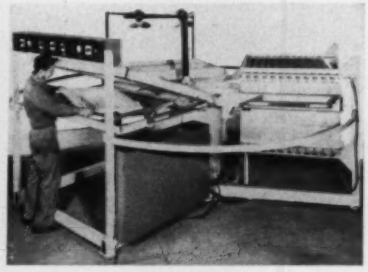

Vacuum Forming

Addition to line of vacuum forming machines is called the Rotary-Vac. The machine works on a three-stage principle. The operator remains at one station where a finished form is unloaded and the clamp frame reloaded with a plastic sheet. During this operation, a sheet is being heated at the second stage, and a heated sheet is being vacuum formed at the third stage.

The heating and forming operations are automatic. After loading the clamp frame, the operator closes it by means of two safety switches. The carriage carrying the clamp frame then automatically moves to the heating stage, the heated sheet to the forming stage, and a finished product to the operator. The oven at the heating stage is completely enclosed. Two banks of Thermatron heaters sandwich the plastic sheet assuring quick and even heating. The upper and lower banks of heaters are each controlled from independent percentage input timers. Either bank may be cut out when working with extremely light gage materials. Vacuum molds are attached to the molding platen which has a 17-inch stroke. Two vacuum ports make possible forming on two molds at the same time. **Comet Industries,** 9865 Franklin Ave., Franklin Park, Ill.

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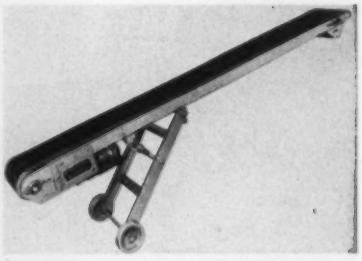

Portable Belt Elevator

Suitable for truck loading or warehouse piling where portability is desired, as part of a highly flexible conveyor system, or to assembly table operation, portable belt conveyor is called the Handibelt Boom. The unit is adaptable to unlimited levels or inclined planes to 26 degrees. The discharge end may be supported several ways. The boom is available in lengths of 11, 16 and 21 feet. Each length is available with 14 or 20-inch wide belting. **Standard Conveyor Co.,** Dept. A, N. St. Paul 9, Minn.

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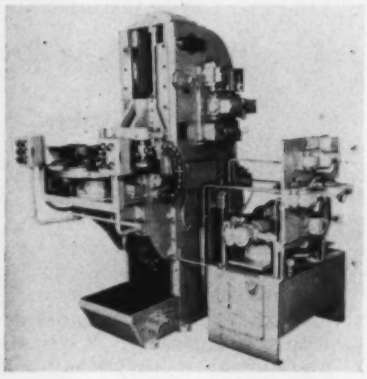
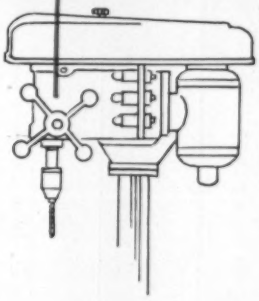


Push-Down Broaching

Tooled to assemble bushings into cover parts and burnish in a continuous operation, 6-ton, 24-inch stroke vertical push-down broaching machine is designated Model T-6-24. With a 6.0 second cycle, and based on 100 per cent efficiency, 400 completed parts per hour can be produced. The machine is completely electrically controlled and hydraulically operated from a self-contained pump and tank unit. Tooling consists of a two-station push head, special dial type index units for carrying the

LET'S *Automate* A DRILL PRESS



Like to know more about it?

These two free booklets tell the entire story. Write for them today. Address: Dept. AU-457, The Bellows Co., Akron 9, Ohio. In Canada: Bellows Pneumatic Devices of Canada, Ltd., Toronto, Ontario.

There are more hand fed drill presses in use than any other machine tool. They are all pretty much alike. The operator positions the work in a jig or fixture, feeds the drill in and out of the work by turning a star wheel by hand, and removes the work from the jig.

A good workman can drill a clean hole. But not too many of them. It's a tiring job. Towards the end of the shift both quality and quantity suffer.

Let's put a Bellows Drill Press Feed on the star wheel shaft. Now, the operator touches a lever. Automatically the drill is fed in and out of the work, under perfect control. Production is increased 20%-30%; quality is better; tool life longer.

Let's go a step farther. Add a Bellows Rotary Feed Table. Now all the operator has to do is load parts. The table automatically positions the part under the drill. the drill press feed automatically feeds the tool, the table indexes to eject one part and position another. Production is more than doubled, often more than tripled.

How much does such a set-up cost? Roughly five weeks wages of an operator buys it. Actually it costs nothing. It pays for itself, often with the first week's cost savings.

The Bellows Co.

AKRON 9, OHIO

MANUFACTURERS OF CONTROLLED-AIR-POWER DEVICES FOR FASTER, SAFER, BETTER AND **LOWER-COST** PRODUCTION

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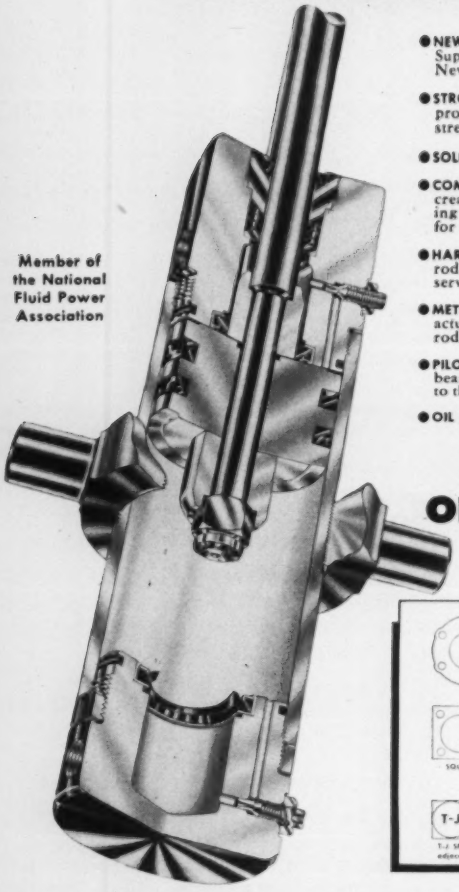
all the EXTRAS are standard with

T-J Spacemaker CYLINDERS



Member of the National Fluid Power Association

- **NEW** *exclusive* ingenious cushion designs . . . Super Cushion Flexible Seals for Air . . . New Self-Aligning Master Cushion for Oil.
- **STRONGER** than outmoded tie rod design, proven through actual tests. No tie rods to stretch.
- **SOLID STEEL HEADS** throughout the full line.
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- **METALLIC ROD SCRAPER**, not just a wiper, actually removes foreign matter from the rod.
- **PILOTED PACKING GLAND** with extra long bearing. Additional strength and support to the piston rod.
- **OIL** pressure to 750 p.s.i. AIR to 200 p.s.i.

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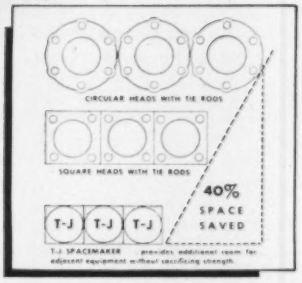

You *save 40% space* when you switch from outmoded tie rod cylinders to the T-J Spacemaker! It's stronger, too! Fits right into automation programs in countless plants. Delivers top performance and dependability with a big *plus* in advanced features. Wide range of styles, capacities . . . reduces man-hours and costs in all kinds of push-pull-lift jobs. Off-shelf delivery in 64,000 combinations!

NEW LITERATURE—Send today for new Catalog SM56 with complete engineering details on Spacemaker line. Write The Tomkins-Johnson Co., Jackson, Mich.

T-J TOMKINS-JOHNSON
RIVITORS AIR AND HYDRAULIC CYLINDERS CUTTERS CLINCHORS

cover parts through the separate operations, magazine and transfer slide for feeding bushings, and magazine and return for burnish balls.

The machine cycles as follows: Cover parts are loaded, either automatically or manually, at the front of the table; table indexes clockwise to assembly station where bushings are fed onto the part; machine ram moves down to press fit bushing into the cover part and returns to position; table indexes the completed assembly to burnishing position; and burnishing ball is forced through bushing simultaneously with new assembly operation at the first station. **American Broach & Machine Co.**, Ann Arbor, Mich.

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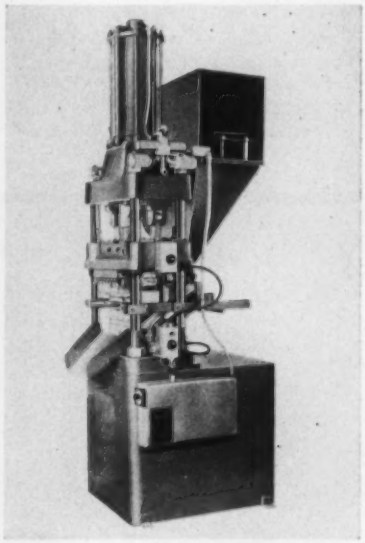

Compression Molding

Working on reduced air line pressure, Model A50-B Automold press produces a full 50 tons on 100 psi in automatic compression molding operations. Ruggedness and ability to withstand higher pressures are built into the press, so that should the operator wish to increase his pressure to 120 psi, the press produces a full 60 tons. Another new feature of the press is a three-roller toggle system for increased stability and better performance. **Automatic Molding Machine Co.**, 3217 Exposition Place, Los Angeles 18, Calif.

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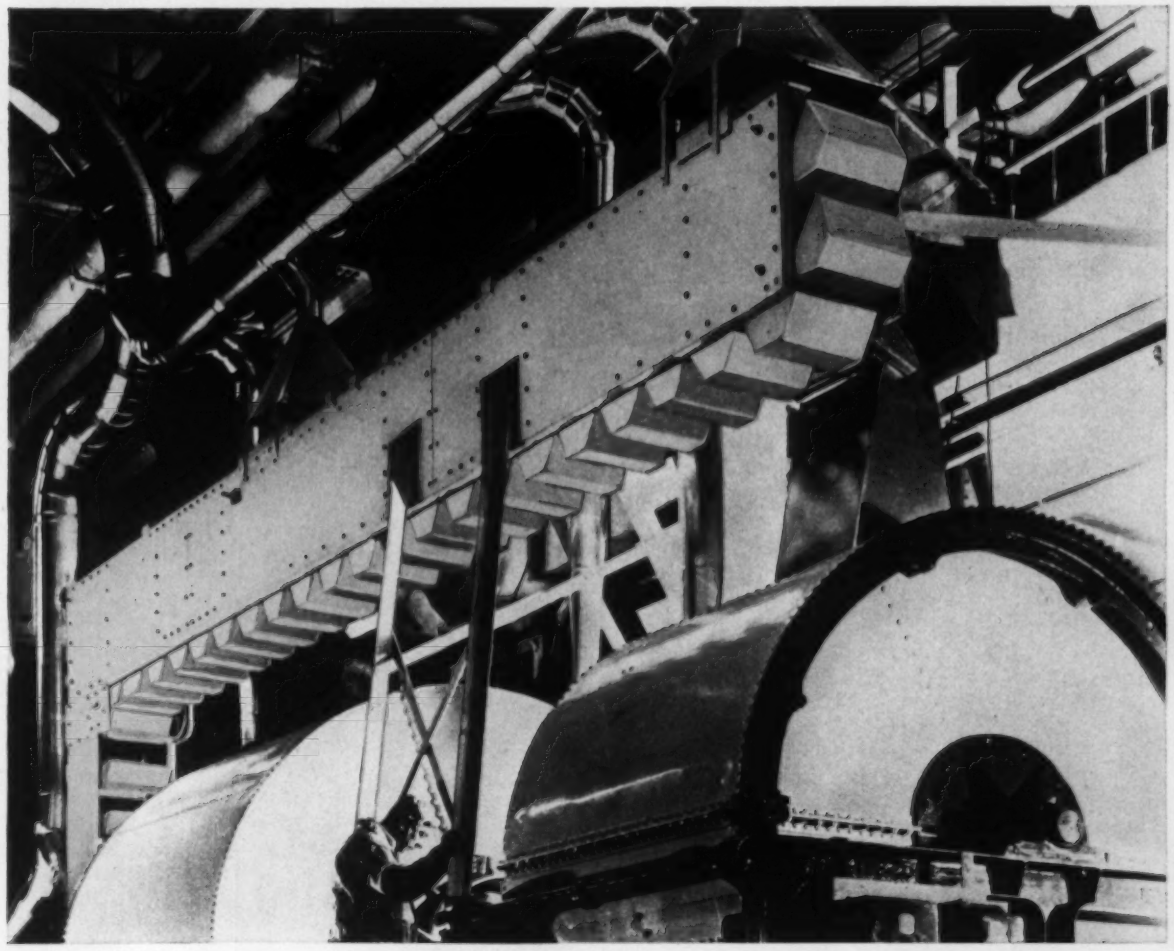

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Robo-Lift moves any bulk material horizontally and vertically... gently and without costly rehandling. Gentle filling-without-scooping makes Robo-Lift suited for handling foods, drugs, compounds, powdered metals and components. Each installation is custom designed for integration with existing production and packaging machinery. In photo above, Robo-Lift carries dry tea. One man controls discharge of tea into both blenders to bring new speed and economy to this batch operation. Our new folder describes the advantages of Robo-Lift. Write today for your copy of "Up...and Over!"

ROBO-LIFT BUCKET ELEVATING CONVEYORS

LYNCH ROBO
CORPORATION
A Division of
LYNCH CORPORATION
Anderson, Indiana

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Dependable...

PRODUCTION MACHINERY

GREENLEE

Automatic Bar Machines

SIX AND FOUR-SPINDLE AUTOMATIC BAR MACHINES

GREENLEE Special Machine Tools

- Multiple-Spindle Drilling and Tapping Machines
- Transfer-Type Processing Machines
- Hydro-Borer Precision Boring Machines

BOOST PRODUCTION REDUCE DOWN TIME

It's easy to maintain rigid production schedules . . . prevent costly bottlenecks with Greenlee Bar Automatics. They are always on the job . . . give continuous, reliable service.

You hear much comment about Greenlees' uninterrupted, round-the-clock performance in widely different industries. With good reason, too, for Greenlee offers years of manufacturing experience... plus manufacturing integrity not often duplicated.

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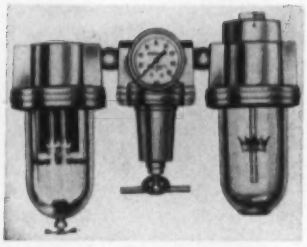
AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems

For detailed information and literature, use card page 17



Air Line Devices

Designed for use in compressed air lines, line of filters, regulators, and lubricators is known as the Crown Line. The units are developed to provide maximum air flow capacity for their rated pipe sizes. The combination devices are available in seven styles and five pipe sizes from ¼ to 1 inch. Regulators are also available in 1¼ and 1½ inch pipe sizes. **Hannifin Corp.**, 542 S. Wolf Rd., Des Plaines, Ill.

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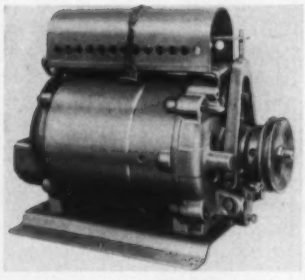

Power Transmitter

Designed primarily for use in driving high production machine tools, textile machinery, winding and spooling equipment and conveyors, solenoid operated power transmitter remotely or automatically controls rapid stop-start machine operation. The motor uses a constantly running motor driven flywheel with a short throw clutch. The clutch is actuated by two solenoids arranged in tandem and normally supplied for 115v, 60 cycles. One engages the clutch and the other engages the brake. Control is accomplished by a stop-start pushbutton station or can be automatic through the use of limit switches, sensing devices, timers or other controls. The power transmitter, designated Type J, is totally enclosed, fan cooled with prelubricated bearings. **Diehl Mfg. Co.**, Finderne Plant, Somerville, N. J.

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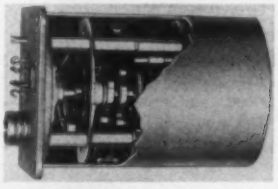
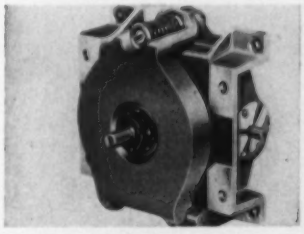


Timing Device

Hermetically sealed time delay relay measures approximately 2⅜ by 2⅜ by 3 5/16 inches and weighs 30 oz or less. Called the Type 825, the timer meets environmental requirements for aircraft and ground installations. It is available with from one to six contacts, with time cycles from fractional seconds to multiple hours. Illustrated timer has provision for external timing adjustment.

A synchronous timing motor is used for 60 and 400-cycle applications. For dc applications, either a permanent magnet type motor or a governor controlled motor may be used, depending on accuracy requirements. **Industrial Div., Eagle Signal Corp.**, Moline, Ill.

Circle 439 on Inquiry Card



Ball and Disk Integrators

Designed for use in computing systems requiring the mechanical solution of differential equations, ball and disk integrators are included in the Helipot line of standard electromechanical breadboard parts. Other applications include use as a control or sensing element in servosystems or as a servosystem output in rate generators.

The ball carriage has a 2-inch maximum travel and the recommended maximum output torque is 5 oz-inches. The torque required to move the ball carriage at its input shaft is 1 oz-inch. Maximum disk input torque required at zero load is 3 oz-inches and maximum recommended speed of the integrator is 1000 rpm. **Helipot Corp., Div., Beckman Instruments Inc.**, Newport Beach, Calif.

Circle 440 on Inquiry Card

Indicator Light

Designed for industrial control and annunciator panels, twin-lamp rectangular indicator light contains abbreviations, words, or en-

tire phrases engraved on its 1⅜ by $\frac{9}{16}$-inch plastic lens face. The Type L5500 indicator allows quick, accurate comprehension of the illuminated message without the need for interpreting the meaning of tiny individual lights. More than 40 of the rectangular units fit in a space 9 inches long by 5 inches high. The two lamps act as a safety check, should one burn out. **Hetherington Inc.**, Sharon Hill, Pa.

Circle 441 on Inquiry Card

Flow Control Valve

Designed to provide predictable flow control in a low flow range, Microflo valves have tungsten carbide plugs in 25 interchangeable sizes. Pilot plants and laboratories can scale down their process to more manageable proportions with these valves. Product quality in full-scale processes can also be improved by more accurate metering of minute flows.

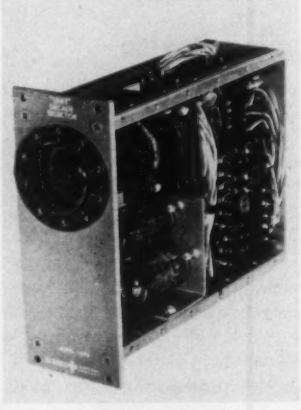
Microflo valves with solid Stellite splines numbered from 1 to 15 provide control of flows from Cv (max) of 0.63 (#1) to Cv (max) of 0.0010 (#15). Tungsten carbide spline also covers the #1 to #15 ranges and in addition is designed in ten new sizes to include Cv (max) of 0.00063 (#16) to Cv (max) of 0.000010 (#25). The flow coefficient (Cv) values are equal to the rate of flow in gpm of water at full 1-inch plug lift and at a 1 psi pressure drop. At a 100 psi pressure drop, for example, the flow rate coverage of the tungsten carbide splines would range from 23,850 cc per minute (#1 max) to 0.0075 cc per minute (#25 min). **Hammel-Dahl Co.**, 175 Post Rd., Providence 5, R.I.

Circle 442 on Inquiry Card

Pressure Transmitter

Developed for pneumatic transmission of process pressure measurements, Model 44 pressure transmitter measures pressures of 0 to 30 inches of water to 0 to 6000 psi, transmitting a 3 to 15 psi air signal to indicating, recording or controlling instruments. To accommodate the various ranges, a choice of standard Foxboro pressure elements is offered: Spirals, helicals, bellows and diaphragms. Element materials are available for corrosive process fluids. Eliminating the need for a separate field gage, the transmitter has an eccentric indicating scale, 4⅛ inches long, built into the front of the case. **Foxboro Co.**, Foxboro, Mass.

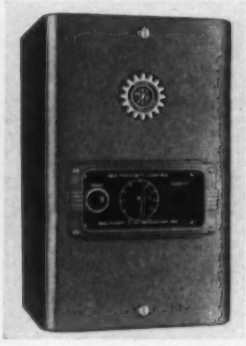
Circle 443 on Inquiry Card



Decade Counting Strip

Well suited for counting and data readout applications, 10-wire output strip can be used in computers, punch card systems and multiple sequence preset counters for data processing, recording and production control. Construction of the unit enables combination with other strips to meet a wide variety of instrumentation requirements. Maximum counting speed is 4 kc. Minimum input requirement is a 15v positive pulse at least 100 microseconds wide; output signal is a 30v positive pulse. **Baird-Atomic Inc.**, 33 University Rd., Cambridge 38, Mass.

Circle 444 on Inquiry Card

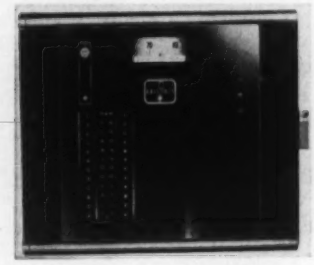


Proximity Control

Designed to detect the presence of an insulator or conductor at the detecting point without making contact with the surface, electronic proximity control is designated MEK-3030. The device can be used as a limit switch which does not require physical contact with the controlling surface; as a level control of such materials as soap, coal, oil, etc.; or as an interface control between two dissimiliar fluids. The control includes such features as voltage regulation, plug-in relay, and visible contacts. Input voltage is 115, 60 cycles; line consumption is 25 va. Relay capacity is 5 amp, 115v.

The device operates on a principle of high frequency energy. The presence of the material close to the detecting element is reflected into the electronic circuit as an increase in loading. This loading is detected and amplified to operate the relay. Several different types of detecting elements are offered to handle the varied requirements of the industrial electronic field. **Machinery Electrification Inc.**, Northboro, Mass.

Circle 445 on Inquiry Card

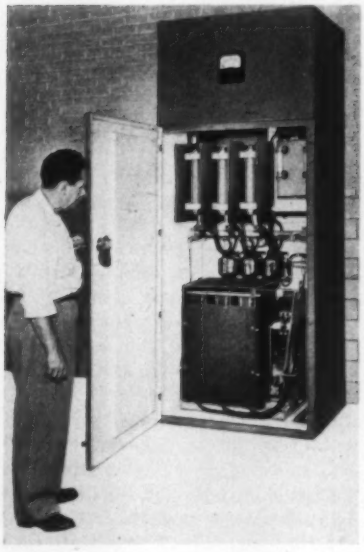


Drum Type Indicator

Developed for quick readings of variables at remote points, drum type precision indicator uses standard Dynamaster electronic instrument components. The indicator is offered primarily in resistance thermometer and pyrometer models, but can also be supplied for measuring other variables.

It is equipped with numbered pushbutton switches on the front of the case, and can quickly scan up to 48 remote points. The revolving drum type scale has a calibrated length of over 26 inches. Full scale travel takes place in 4½ seconds. **Bristol Co.**, Waterbury 20, Conn.

Circle 446 on Inquiry Card



High Voltage Starter

Compactness and accessibility are features of high voltage starter, designated Type ZHA. Operating on 2200 to 4800v, the unit is completely accessible from the front, and may be mounted direct-

Ask Standard

how to

cut costs

with

conveyors

Standard limit-switch-controlled Automatic Reciprocator is one of two used to form 200-ft. overhead detour of dehumidifier assembly line.

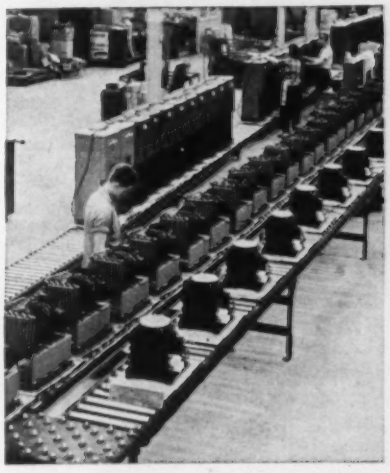
"COMPLETE CONVEYORIZING" . . . what it did in a smaller plant

Products at Ebco stay on conveyors until packaged and sent to shipping.

Ebco Manufacturing Company — employing 275 people to produce water coolers, beverage dispensers and dehumidifiers — has realized substantial savings by completely conveyorizing their operations. Ebco engineers planned for an orderly conveyor system when developing plant layout and building design; consequently conveyor system costs were kept "low" and resulting efficiency is "excellent."

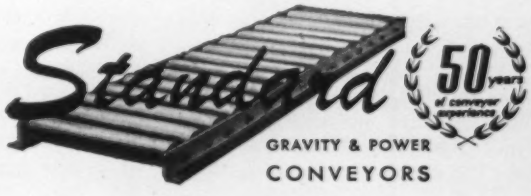
Similarly, it will pay you to take another close look at your present conveyor system. Standard specialists will be pleased to help you make evaluations . . . recommend the proper equipment and its application to meet your specific needs.

STANDARD CONVEYOR COMPANY, North St. Paul 9, Minnesota. Sales and Service in Principal Cities.



Gravity roller conveyors like this, used for Ebco's assembly lines, are inexpensive, easy to set up, and economical to maintain.

For details on Standard Conveyors of all types, contact the Standard representative listed in your classified phone book or write direct. Ask for Bulletin EE-4.



Circle 596 on Inquiry Card

ly against wall (illustrated) or in double rows, back to back. The starter is only 30 inches deep.

The self-contained device is complete with control transformer supplying low voltage for pushbutton circuits. When starters are ganged, only one incoming feeder is required. Additional starters can be added as needed. The Type ZHA is also available with self-contained bus in an isolated compartment. It is furnished in three interrupting ratings for squirrel cage, synchronous and wound rotor motors: Class E1—50,000 kva; Class E2—to 250,000 kva; Valimitor—may be used on bus of unlimited short circuit capacity. **Electric Controller & Mfg. Co., Div., Square D Co.,** Cleveland 28, O.

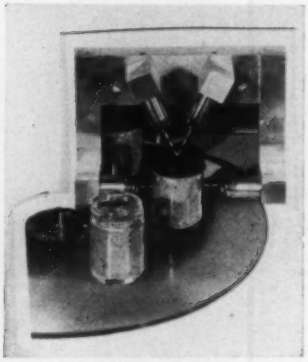
Circle 447 on Inquiry Card

Pilot Control Valve

Developed for use with diaphragm actuated regulating valves, pilot control valve responds to small variations in controlled pressures in the flow line, and thereby readjusts the main regulator for precise throttling of the steam, gas or liquid flow. Designated No. 811 or 811-R (reverse acting type), the unit accurately positions diaphragm control valves used either as reducing or unloading valves.

The device consists basically of a two-way valve actuated by a diaphragm opposed by a loading spring. Controlled pressure ranges are 3 to 15 psi, 10 to 40 psi and 25 to 100 psi. Minimum operating pressure of 30 psi is required. The valve is fitted with pressure gages to indicate the inlet hydraulic pressure and the load line pressure to the diaphragm operated regulating valve being controlled. **Atlas Valve Co.,** 280 South St., Newark, N. J.

Circle 448 on Inquiry Card

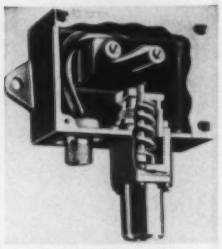


Dual Beam Electric Eye

Designed to eliminate timers and mechanical contacts in monitoring objects moving at random positions and varying speeds, electric eye controls have dual light beams. One beam times the inspection and the other monitors it. The beams may be direct light cut off or reflected, or a combination of both. In some cases, additional beams may be added to monitor two or more parameters when the timing beam indicates inspection.

The illustration shows an application for checking the presence of bottle caps. The timing beam is cut by the bottle and the reflecting beam inspects for the cap. Both beams must concur in order to pass assembly. The assembly is small enough to fit into difficult places in assembly, printing and packaging machines. **ESS Instrument Co.,** Bergenfield, N. J.

Circle 449 on Inquiry Card

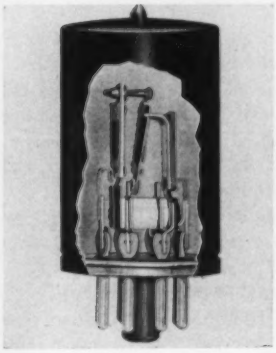


Pressure Switch

Capable of operating from 0 to 1200 psi and withstanding pressures as high as 3000 psi without distorting its pressure element, pressure switch is both hydraulic and pneumatic in operation. The switch is adjustable over its entire range of pressure, and adjustments can be made without interfering with the pressure element.

The switch is totally enclosed and weatherproof. It uses any limit switch, and operates on 15 amp, 120 to 460v, ac with single-pole, double-throw silver contacts. The device is available for dc application, and can be arranged for wall or bracket mounting in any position. **Alloy Bellows Engineering Co.,** 18125 Roseland Rd., Cleveland 12, O.

Circle 450 on Inquiry Card



Time Delay Relay

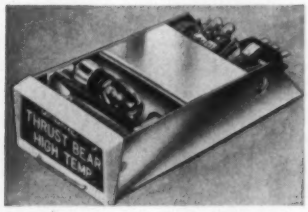
Used in motor controls, decoding devices, furnace controls, low speed servos, pump controls, etc., bistable time delay relay has single-pole, double-throw snap action contacts. Termed a "Thermal Memory Relay", unit is thermally operated, having two separate heater circuits. Each heater serves to transfer a movable arm from one contact to the other. Being bistable, the relay remains in either of the two contact positions until operated by means of the appropriate heater circuit. Because of the thermal actuating characteristics, a time delay is associated with each operation.

The relay is temperature compensated from −55 to 100C and has standard voltage ratings of 6.3, 26.5, or 117v. **Thermal Devices Sales Dept., Electronics Div., Curtiss-Wright Corp.,** 631 Central Ave., Carlstadt, N. J.

Circle 451 on Inquiry Card

Annunciator Unit

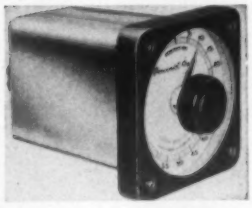
Redesigned unit type construction of Electro-Pane annunciator



includes a plug-in drawer assembly which contains the switching section, the illumination, the color filter and nameplate complete with visored frame. Glass sealed mercury switches are actuated by solenoids.

Four illuminations of nameplate define four operating conditions: (1) normal, with window nameplate darkened; (2) alarm, with bright amber light and audible signal; (3) pending, with red light and signal silenced; and (4) clear, with green light and audible signal. Acknowledgment and resetting is accomplished by one pushbutton per installation. Solenoid mercury switching assemblies are available in remote cabinets for illumination of smaller nameplates or jeweled pilot lights in flow diagram panels. **Electro Devices Inc.**, 4025 Easton Ave., St. Louis 13, Mo.

Circle 452 on Inquiry Card

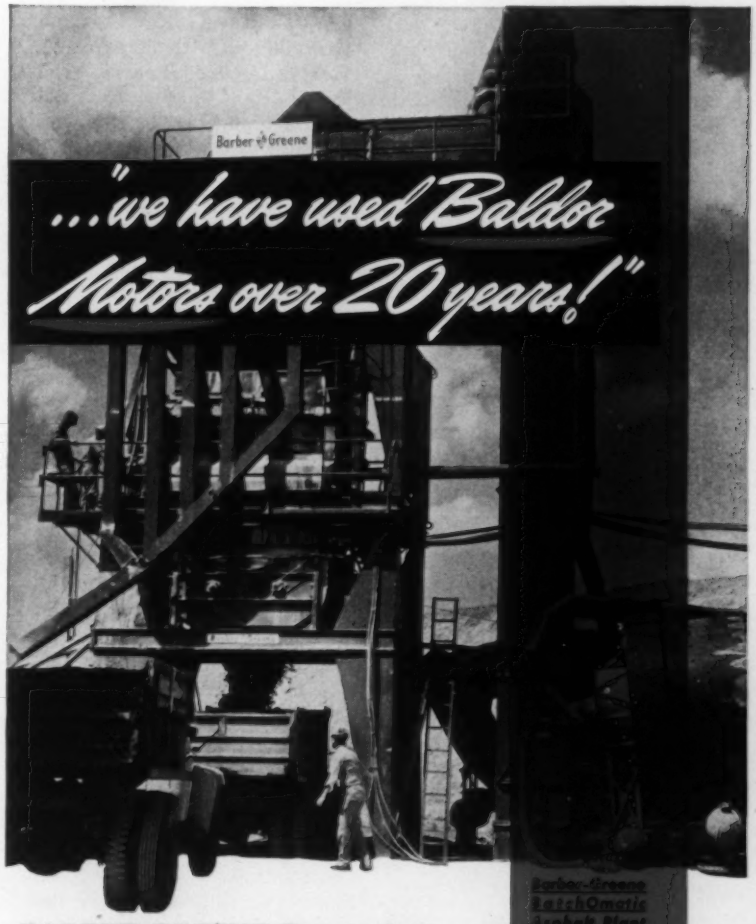


Adjustable Interval Timer

Developed as an alternate for rheostats and other variable voltage equipment, Percent-O-Cycle timer eliminates waste of power on electric furnaces, heaters, dehumidifiers, evaporators, dryers, materials pressers, filters, pumps, etc. Loads up to 25 amp at 150v, 60 cycles may be handled without auxiliary equipment.

In operation, the Model 75 timer closes a contact for an adjustable interval in a fixed time cycle with repeat accuracies less than 0.1 per cent. Standard time cycles are from 15 seconds to 8 hours. **Hagen Mfg. Co.**, 202 20th St., Moline, Ill.

Circle 453 on Inquiry Card



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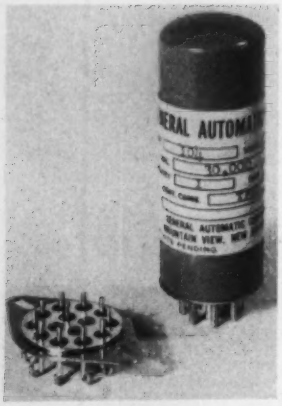
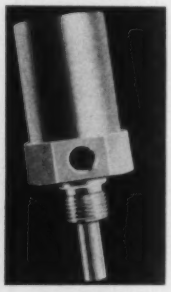


High Speed Relays

Featuring operation as fast as 2 milliseconds, high speed relays are designed for dc applications. Designated as Type 120, the relay is available hermetically sealed, with a dust cover, or open with contact combinations from single-pole single-throw to triple-pole double-throw. The relay is also available for ac operations by using selenium rectifiers or diodes.

The device incorporates a complete wiping action which eliminates bounce and chatter at normal operating voltages. Power requirement ranges from 0.25 to 2.5w, depending on the speed requirements. Coil resistance available is from 0.01 to 30,000 ohms. Contact capacity is 1 amp inductive or 3 amp resistive at 115v ac or 29v dc. **General Automatic Corp.,** 12 Carlton Ave., Mountain View, N. J.

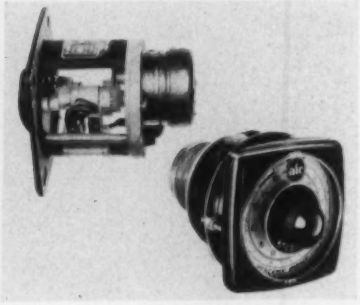
Circle 454 on Inquiry Card



Small Bore Cylinders

Useful for activating electrical contacts in test jigs and fixtures, as miniature air vices, and in automatic work for feeding, ejecting, soldering, welding, brazing, stamping, bending, marking and assembly operations, line of miniature air cylinders with bores of ¼, ⅜, ¾ and 1½ inches is designed for use in light production positions or new products. The cylinders are designed with ⅛-inch thick brass tube wall. The blind ends are silver brazed to the tube, and the front gland piston rod end is internally threaded, allowing for easy repairs when needed. **Airmatic Valve Inc.,** 7317 Associate Ave., Cleveland 9, O.

Circle 455 on Inquiry Card



Input Controller

Used in ovens, furnaces, dryers, evaporators, dehumidifiers, etc., requiring accuracy in control of operating temperatures, Type J-4A input controller eliminates the use of rheostats. The input controller accurately controls temperatures by interrupting the heating circuits at regular intervals, adjustable on a dial calibrated from 0 to 100 per cent on-time per 60-second basic cycle.

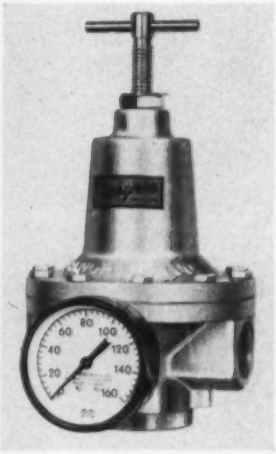
The controller is equipped with synchronous motor, rated for operation from 115 or 230v, 25, 50 or 60 cycles. **Automatic Temperature Control Co. Inc.,** 5200 Pulaski Ave., Philadelphia 44, Pa.

Circle 456 on Inquiry Card

Pressure Regulators

Designed to improve the performance of air-operated equipment, line of pressure regulators is designated Series 20AG and 20AG-X. Their precise control extends over the full operating range, regardless of wide fluctuations in main line air pressure and varying air flow.

Design features of the regulators include: Large air passages, balanced valve construction, improved siphon tube action, greater effective diaphragm area, an accurate relief feature, and a hand removable bottom plug for easier maintenance.



The pressure regulators are also designed for use with water, oil and noncorrosive gases. They are available in pipe sizes from ¼ through 1 inch, in both relieving and nonrelieving types. **C. A. Norgren Co.,** 3400 S. Elati St., Englewood, Colo.

Circle 457 on Inquiry Card

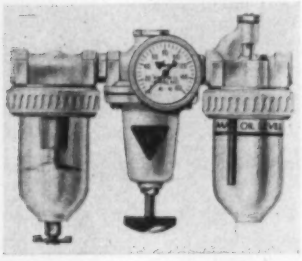
Pressure Pickup

Suitable for applications in chemical processing or similar systems where differential measuring or pressure control devices are used in conjunction with corrosive or conductive fluids, differential pressure pickup has the dry strain gage element isolated from the pressurized fluid. Pressure differences are transmitted from a single diaphragm through a mechanical linkage to an unbonded-strain gage element capable of high frequency performance.

Isolation of the strain gage ele-

ment is accomplished by a double chamber arrangement. The differential pressure chamber contains a single pressure sensitive diaphragm and provides fluid inputs on either side of the diaphragm. Diaphragm deflections are transmitted by a hinged linkage through a force-transmitting seal into a separate chamber containing the strain gage. **Dynamic Instrument Co. Inc.**, Cambridge, Mass.

Circle 458 on Inquiry Card



Air Supply Controllers

Line of combination units for the automatic filtration, regulation and lubrication of air supply to pneumatic operated equipment is available in ¼, ⅜ and ½-inch sizes. The filter features tornado action—a design of contoured air passage which imparts a downward spiral motion to the incoming air. This centrifugal action throws foreign particles and condensation against the sides of the filter bowl where they spiral downward into the quiet zone for accumulation and drain off. The air, thus cleansed of larger particles and condensation, then passes through the porous bronze filter element for final filtering before entering the regulator.

The regulator features an aspirator which provides instant compensation or regulation of the reduced pressure under conditions of sudden, heavy and/or widely varying flow demands.

The lubricator is designed with a high velocity venturi section which assures a high degree of vaporization and assimilation of the metered oil. An internal bypass parallels the venturi and provides a practically uniform pressure drop, even under widely fluctuating flow conditions. **Industrial Div., Watts Regulator Co.**, Lawrence, Mass.

Circle 459 on Inquiry Card

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Your company name and message show up better on brighter, smoother H&D Corabrite corrugated boxes. Improving product identification is always a bright idea. Better see H&D.

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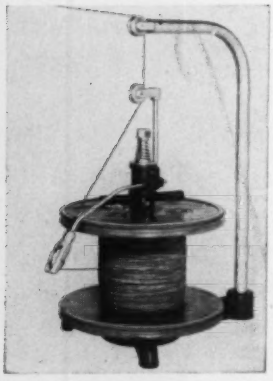
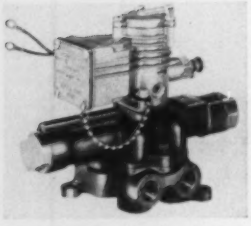


Wire Unreeler

Any type of magnet wire can be removed automatically from 12-inch diameter reels, with safety in handling and complete protection of the insulation, by Model D-54 Spinning De-Reeler. The unit is adaptable for floor or table use with any type winding machine or equipment. The take-off-tension device handles and removes any type of ordinary wire, 15 to 36 gage, and magnet wire.

In operation, a full reel is placed upon the base, after which the rotating flyer assembly is screwed down into it, automatically tightening the reel and assembly to the base. A turn handle gives extra leverage. Wire is spun off by the rotation of the flyer pulley, on uniform tension between two fiber disks (2 inches in diameter) locked on a ⅝-inch spindle. **Associated Production Co.**, 162 N. Clinton St., Chicago 6, Ill.

Circle 460 on Inquiry Card



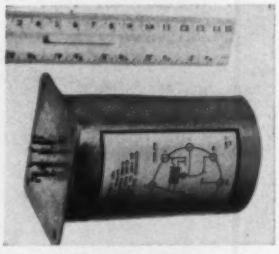
Control Valve

Capable of controlling over 600 cycles per minute, line of solenoid pilot operated control valves is known as the Speed King series. Valves feature: Moisture and dustproof solenoid enclosure sealed to prevent entrance of splashing liquids or airborne contaminants, safety solenoid cover which renders the valve electrically inoperative when cover is removed, and integral junction box large enough to accommodate 6-inch taped pigtail leads.

Valves have a service life in excess of 25 million cycles under normal operating conditions. Solenoid coil, completely enclosed in molded epoxy resin, is guaranteed against burn-out for the life of the valve. Units are available in single and double solenoid types, for foot, subbase or manifold mounting, in ¼, ⅜, ½ and 1-inch pipe sizes.

Pressure ranges in psi are: 35 to 200 air and 35 to 125 hydraulic oil for both single and double solenoid valves with internal pilot supply; 0 to 250 air, hydraulic oil and water for both single and double solenoid valves with external pilot supply; 50 to 125 for water for single and double solenoid valves with internal pilot supply; within 1 inch Hg absolute vacuum for single and double solenoid valves with external pilot supply. **Valvair Corp.**, 454 Morgan Ave., Akron 11, O.

Circle 461 on Inquiry Card

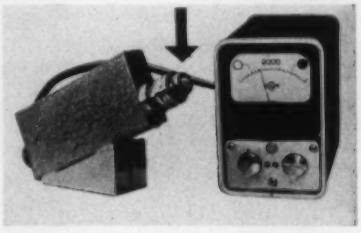


Time Delay Switch

Developed for automatic positioning, remote meter reading and network switching, miniature motorized time delay switch accommodates up to five single-pole, double-throw switching functions. The switch has a timing accuracy of ±5per cent of a total timing cycle under all conditions. Normal delays are from 15 to 30 seconds with instantaneous reset when power is removed.

The switches operate on a range of dc voltages from 6 to 50. Power input is 15w for the motor, 7w for the clutch. At the end of the timing cycle the motor stops automatically, with switch position maintained by a clutch. Power interruptions during or after a timing cycle result in automatic reset. **Globe Industries Inc.**, 1784 Stanley Ave., Dayton, O.

Circle 462 on Inquiry Card



Electronic Inspector

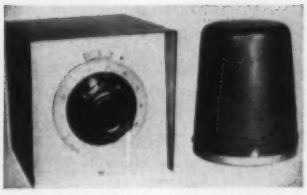
Designed for high speed checking of internal or external measurements of all sizes and types, electronic unit is called the LM-1 Minitron. Illustrated unit is checking the ID of a race ring. The plug-in console can be set up for any three selections of magnification from 0.00001/Div. up to 0.0001/Div. The inspector provides stability of readings without regard to temperature effects, and permits longer operating life. **Industrial Gauges Corp.**, W. Englewood, N. J.

Circle 463 on Inquiry Card

Remote Position Control

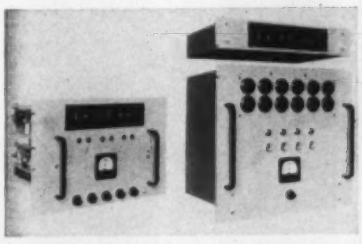
Used for remote or automatic control of valves, variable speed drives, gates and dampers, positioning device is called the Dialtrol. A vernier dial on the face of the control is set to establish accurately the desired position of a valve, variable speed drive control, jack, rheostat, etc. A control motor, with built-in or externally driven potentiometer, adjusts the valve, drive, etc., until the proper setting is obtained. The Jordan Shaftrol, a shaft mounted control gear motor with built-in potentiometer, is designed specifically for use with the Dialtrol, but other gear motors connected to suitable potentiometers may be used.

Full scale follow-up accuracy of ±1/5 of 1 per cent is standard but precision multiturn potentiometers may be used to provide accuracies



of 1/25 of 1 per cent. The unit incorporates adjustable anticipation to slow down the control motor as the desired setting is approached. In this way overtravel is prevented and the desired setting is reached without hunting. The Dialtrol provides direct control for motors up to 1/8 hp and controls motors up to 50 hp through a reversing starter. **Jordan Co. Inc.**, 3235 W. Hampton Ave., Milwaukee 9, Wis.

Circle 464 on Inquiry Card



Rapid Access Devices

Digital timing generator, Model 201, and magnetic tape search unit, Model 202, are designed to provide automatic high speed access to selected data in Ampex recorders and similar multichannel magnetic tape instrumentation systems. The digital timing device generates numerically coded timing signals which are recorded on the magnetic tape throughout the data recording periods, providing a precise digital index in terms of elapsed time. The generator also visually displays exact time in hours, minutes and seconds as illuminated digits.

The magnetic tape search unit operates during data reduction periods. On the basis of time indices recorded on the tape by the generator, this instrument automatically locates and selects for controlled playback the tape data included between a sequence start time and a sequence end time specified by panel dial settings. The time index is visually displayed as illuminated digits on a small separate panel

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Our Catalog A-10 contains complete information on the entire line of Buckeye abrasive tools, all of it both interesting and helpful to all portable tool users. If you don't have a copy, send us your name, company and address and we'll correct that situation promptly.

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MARKED IMPROVEMENTS in

IDENTIFICATION AND DECORATION

A voice from the shelf... that says "Here's the paint ...drug... oil... you're looking for..." would certainly help both buyer and seller. Attractively lithographed cans do "talk" this way, but one trouble has been high production runs of lithographed cans vs. the short run needs of variables such as color names, batch numbers and date codes. Markem suggested imprinting the variables on partially lithographed cans, as they are needed, and built the 70AF machine to do the job. Today a fair number are in use, imprinting little 1/32 to full gallon sizes, areas to 2" x 6", at rates up to 1500 an hour (an even faster rotary machine is underway). Beats torn, smudged or missing paper labels all hollow.

"Elephant trunk" marker *... is not the usual way Markem describes its machines, but for the 89A, the nickname has stuck. This is a typical Markem "Special Products" development, for marking tradename and size on tubular rubber insulation. The inelegant nickname originated because the material is a six foot length of gray tube 1¼" to 5" in diameter. It is fed into the machine, passes under the printing head and ejected by a lower drive roll. Adjustments for different diameters are easily made, and other useful features include mobility for use in different locations, variable speed motor, excellent imprint quality with Markem's jasmine yellow marking compound. The people who worked out this "Special" perhaps can help you, if you have a yet-unanswered problem in identification/decoration marking.*

"Do-it yourself" *... is often prompted by economy reasons. In marking products, however, the manufacturer who "does it himself" not only saves money, but also gets what he wants when he wants it. Here's what we mean: a company making plastic cases for eyeglass lens cleaner had the product name and directions imprinted on the containers by a job printer. The method was neither convenient or economical. The local Markem man presented a case for the 20A machine, and it gave a good account of itself in an 80-prints-per-minute run. Having another satisfied customer makes us happy, and he's tickled with the quality, convenience, and prospect of the 20A paying for itself in six months.*

Is there a shape, surface or size giving you trouble in efficient marking? Try the Markem Method — a source of better marking for 46 years. Write Markem Machine Co., Keene 37, N.H.

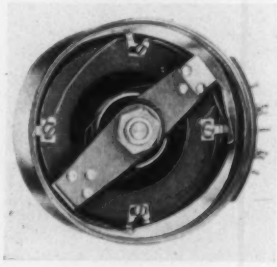
MARKEM

Circle 600 on Inquiry Card

which may be remotely located.

Tape speeds of 1⅞, 3¾, 7½, 15, 30, or 60 ips are available for recording; the same six tape speeds plus high speed search rate for playback, and forward or reverse directions are other features. **Dept. DR, Hycon Eastern Inc.,** 75 Cambridge Parkway, Cambridge 42, Mass.

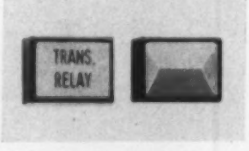
Circle 465 on Inquiry Card



Potentiometer

Designated Model C-300, precision sine-cosine function potentiometer affords two separate voltage outputs. Independent brush contacts are mounted on a common shaft 90 degrees apart to produce accurate sine and cosine voltages. Function accuracies of 1 per cent are standard; function angle is 360 degrees. Mounting designs include servo, three-hole with central pilot or threaded bushing. Multiple ganged units are available with sections in simultaneous or other conformity. **Electronic Sales Div., DeJUR-Amsco Corp.,** 45-01 Northern Blvd., Long Island City 1, N. Y.

Circle 466 on Inquiry Card

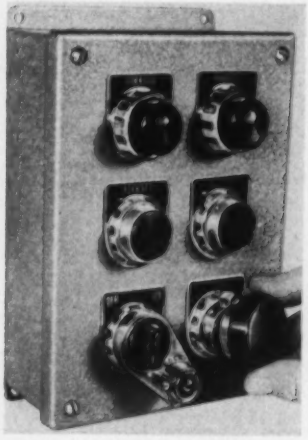


Indicating Lamps

Capable of multiple use for a simple annunciator assembly, rectangular indicating lamps are designed to permit the designation to be engraved directly on the lens, eliminating the separate nameplate. The lamp units are available with flat or prismatic lens, the latter for wide range side visibility.

The Model T3¼ single-contact miniature bayonet lamp bulb is for low voltage application, for 120 to 220v service with a 10w resistor, externally bracketed and secured by the lamp unit. The NE-51 neon bulb is also used with prism lens on 120 to 220v, with the required resistor incorporated in the socket assembly. Lamps are available in two sizes: 1 13/32 by 31/32 inches and 31/32 by 11/16 inches. **H. R. Kirkland Co.,** Eight King St., Morristown, N. J.

Circle 467 on Inquiry Card



Oil Tight Pushbuttons

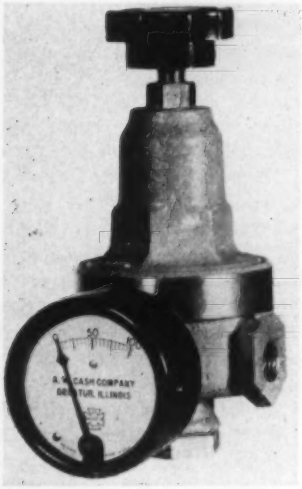
Used for remote pilot control of magnetic controllers and similar devices, line of oil tight, heavy duty pushbuttons is rated to 550v ac-dc. The line includes pushbuttons, selector switches, selector pushbuttons, pilot lights and accessories such as mushroom head, lever and key lock.

All units are built around one standard contact block—no rights or lefts. These contact blocks can be used singly or in tandem, mounted vertically or horizontally.

The operator consists of a metal button or selector knob which is free to slide or rotate within a metal sleeve. A special seal prevents oil from entering the enclosure and the switching mechanism. There are no diaphragms to rupture or puncture. Standard buttons are used for all accessories. The mushroom head, lever or key lock are front mounted without removing the unit from the panel. Accessories can be shifted easily from

one button to another without interrupting the operation of the panel. Oil tight pilot lights are built for direct voltage, transformer or neon application. **Furnas Electric Co.**, 1128 W. McKee St., Batavia, Ill.

Circle 468 on Inquiry Card



Pressure Valve

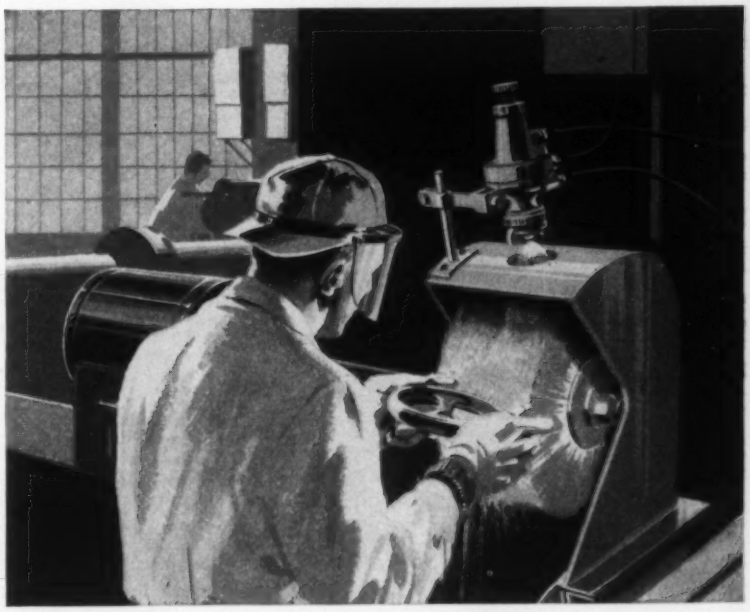
Accurate pressure control of air, water, oil, steam and most liquids and gases is provided by new pressure reducing and regulating valve. Type 3381 valve can operate at inlet pressures as high as 400 psi at 150F, and at 250 psi at 400F. Fire spring ranges are available from 5 to 300 psi delivery pressure.

Valve can be supplied with a pressure gage, mounted in either of the two outlet connections. Features of Type 3381 include: Elimination of cap screws for easier maintenance and servicing, and increased spring length for greater sensitivity and improved regulation. **A. W. Cash Co.**, P. O. Box 551, Decatur, Ill.

Circle 469 on Inquiry Card

Proximity Pickup

Ideal for counting small metal parts such as screws, nuts, washers, and bolts, hollow coil proximity pickup features a connector located on the coil. Model 4920-AN pickup is designed for use with Electro's proximity transducer systems. The device uses a hollow phenolic table

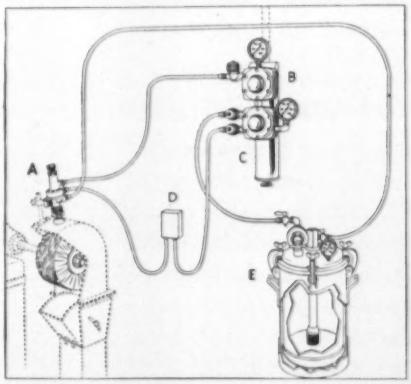


DeVilbiss spray guns make his buffing time fully productive

The time your operator spends in manually compounding, handling polishing and buffing bars is saved for productive work when compounds are spray-applied. And the DeVilbiss spray method offers the most efficient way to keep wheels properly conditioned for faster, consistently high-quality work!

Compounds are uniformly applied—in just the right amount—at the simple touch of a valve . . . or by means of an automatic control. The result: important savings in time and material. Waste through nubbins, and broken pieces is completely eliminated!

Call our nearest supplier for profit-saving information about DeVilbiss spray systems for polishing and buffing applications.



Complete DeVilbiss low-pressure "unit" system adapts to large or small manual or automatic installations. System includes (A) spray gun, (B) air transformer, (C) air regulator, (D) 3-way control valve, (E) pressure-feed tank, and hose.

THE DEVILBISS COMPANY
Toledo 1, Ohio
Santa Clara, California
Barrie, Ontario
London, England

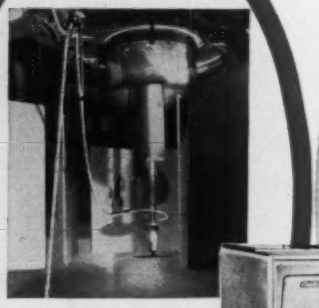
Branch Offices in Principal Cities

FOR BETTER SERVICE, BUY
DEVILBISS

DEVILBISS HELPS YOU GET THE MOST FROM THE SPRAY METHOD

Circle 601 on Inquiry Card

NO REASON WHY YOU CAN'T DO IT, TOO!



Typical of the Mueller Climatrol line is this summer air conditioner and gas-fired winter air conditioner, now uniformly painted electrostatically with RANSBURG NO. 2 PROCESS

MUELLER CLIMATROL,
Milwaukee, increases paint mileage **40%** with
RANSBURG NO. 2 PROCESS

And, 10 men averaging 40 hours a week now do the work formerly handled by 24 men averaging 50 hours!

Painting used to be a bottleneck in the manufacture of heating and air conditioning equipment at Mueller Climatrol.

But not any more!

When Mueller modernized its finishing department—replacing hand spray with Ransburg No. 2 Process Electro-Spray—daily production was increased . . . finishing costs were cut . . . and quality of the work was improved.

Annually, Mueller coats over 10 million square feet of sheet metal, so a 40% increase in paint mileage—translated into paint dollars saved—is a sizeable figure. Pointing up other savings, a typical run of 400 furnace casings used to take 200 man hours to clean and hand spray. Mueller does it now in 60 hours!

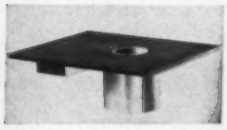
NO REASON WHY YOU CAN'T DO IT, TOO!

Whatever your product, if your production justifies conveyorized painting, chances are one of the Ransburg Electro-Coating Processes can do it better, for less, with improved uniformity and quality of the work. Write for our new brochure which includes numerous examples of both large and small manufacturers of a variety of products who are enjoying the many advantages of *Ransburg Electrostatic Spray Painting.*

Ransburg ELECTRO-COATING CORP.
Indianapolis 7, Indiana

RANSBURG

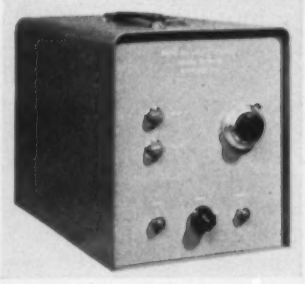
Circle 602 on Inquiry Card



around which the sensing coil is wound. As a high frequency, carrier operated transducer, it works on a principle similar to the military mine detector. It senses aluminum, brass or copper, as well as iron and steel.

The coil can be used as part of a chute or tube carrying metal parts which can either slide or drop through. Connected by means of a cable to a control unit, it causes the control unit to generate dc voltages or operate relays. The control unit can be used to actuate electromechanical or electronic counters and automatic machinery. When electronic counters are used, counting rates in excess of 60,000 per minute can be obtained. **Electro Products Laboratories Inc.,** 4500 Ravenswood Ave., Chicago 40, Ill.

Circle 470 on Inquiry Card



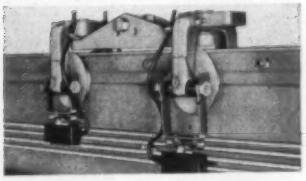
Limit Controller

Accurate automatic inspection, monitoring, and/or control of size, weight, stress, pressure, flow, acceleration or any other quantity measurable by differential transformer transducers is accomplished by Model 561 limit controller. Any desired control point in the range of a standard transducer can be preset on a ten turn dial. Thereafter an output relay closes whenever the input quantity equals or exceeds the preset limit, and opens when it falls below the limit.

Operating time is approximately 0.05-second. Relay contacts operate panel lamps and external alarm or control devices. A null-balance principle gives stable re-

peatability of 0.000025-inch or 0.1 per cent of transducer span. Linearity is 0.1 per cent. **Daytronic Corp.**, 216 S. Main St., Dayton 2, O.

Circle 471 on Inquiry Card

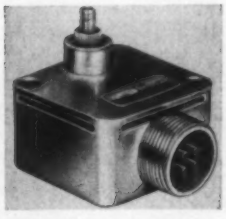


Shielded Electrification

Standard bus bar electrification for MonoRail systems is covered with a specially designed polyvinyl chloride extrusion to provide completely safe electrified systems. Called Kant-Shock, the shielding prevents accidental contact with live bus bars. It is impossible for an adult's finger to enter the shield.

Sliding shoe collector provides a floating contact throughout a monorail system regardless of misalignment due to bent bars, or at switches and interlocks. The shielded electrification is mounted in stamped bracket assemblies for live power feed throughout the system at a maximum rating of 600v, 100 amp. **American MonoRail Co.**, 13107 Athens Ave., Cleveland, O.

Circle 472 on Inquiry Card



Limit Switch

Featuring 360-degree rotary action with 180-degree pretravel and 180-degree overtravel, limit switch is designated #9135. Available in two models, the switch is provided with potted leads or pin connectors. The device operates at 28v dc or 110v ac with 10 amp resistive rating, 4 amp inductive. At 110v ac, (60 to 400 cycle or 220v) the resistive rating is 10 amp. **Haydon Switch Inc.**, Waterbury 20, Conn.

Circle 473 on Inquiry Card

P & B STRIKE SETTLED!

AN OPEN LETTER TO RELAY USERS

Potter & Brumfield, inc.

Dear Friends:

Ruthless violence, culminating on February 13 with the shooting of the four-month-old baby daughter of two of our employees, focused national attention on a recent strike at our Princeton, Indiana plant.

This unjustified strike was called on November 5, 1956 in the face of our "no strike" contract with Local 1459 of the International Association of Machinists. No demands or proposals for settling the strike were made by the Union. Two Company proposals were summarily rejected.

Settlement of the strike was reached on February 28, 1957.

Our plants in Laconia, New Hampshire and Franklin, Kentucky were not affected by the strike.

Production lines were shifted from Princeton to both Laconia and Franklin plants, and employment has been greatly increased at both locations. These plans were made before the work stoppage to increase production.

Production at Princeton was resumed on December 17th, and today a normal work force is manning the remaining lines. Until recently, the training of new workers restricted our productivity, but output now is at satisfactory levels.

With three plants to serve you, we pledge our continued efforts to provide you with relays of the finest quality. Our Engineering Department welcomes the opportunity to work with you on new designs and future projects.

Sincerely,

Dale V. Cropsey

Dale V. Cropsey
Vice President & Director of Sales

NOW!
3 PLANTS TO SERVE YOU

POTTER & BRUMFIELD, INC.
PRINCETON, INDIANA A Subsidiary of AMERICAN MACHINE & FOUNDRY COMPANY

Circle 603 on Inquiry Card

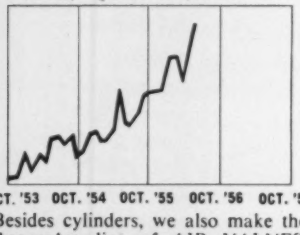
Does VOLKSWAGEN bother *Cadillac?*

We don't make CADILLAC air cylinders and we don't pretend that we do . . .

We do claim that we make very good cylinders at very good prices:

BORE	BASIC PRICE	ADD PER " OF STROKE
1⅛"	$15.50	$.35
1½"	$20.50	$.50
2"	$25.50	$.55
2½"	$29.50	$.65
3"	$32.50	$.95
4"	$47.50	$1.20

We furthermore claim that we work hard to ship from stock and our sales chart tells us that we are being successful on all accounts – PRICE, QUALITY, SERVICE.



Besides cylinders, we also make the ALLENAIR line of AIR VALVES, AIR CLAMPS and DIAL FEED TABLES and if we could tell you right here all there is to tell you about what we offer and how those products can increase your PRODUCTION at MINIMUM COST we wouldn't need the $1.25 24-page catalogue that is available for free this month to anyone seriously interested.

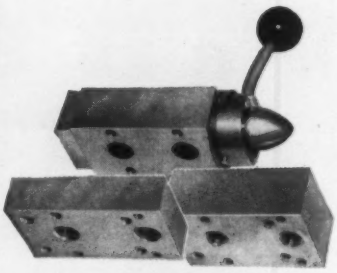
THE A. K. ALLEN CO. A-47
57 Meserole Ave., Brooklyn 22, N. Y.
Name .....
Company .....
Address .....
City ..... Zone ..... State .....

P.S.—*The cylinder pictured is a Factory Reject. The only rods available are straight ones and made out of #416 Stainless Steel ground and polished stock and repolished after machining. The bearing is nylon.*

The answer to the question on top of this page is: *Not one bit. There is a market for both!*

ALLENAIR **THE A. K. ALLEN CO.**
57 Meserole Ave., B'klyn 22, N. Y.

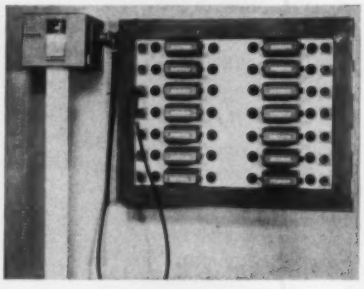
Circle 604 on Inquiry Card



Flow Regulator

Adapted for manifold mounting, Model 1409 Series adjustable flow regulator has a 3000 psi operating pressure. Minimum to maximum flow adjustments can be obtained by 180-degree movement of the control handle. Four sizes provide a flow adjustment range from 0.5 minimum to 12 to 20 gpm maximum. Subplate kits are furnished with built-in check valves for free reverse flow. The regulator is easily installed and weighs only 5 lb. **Waterman Engineering Co.**, 725 Custer Ave., Evanston, Ill.

Circle 474 on Inquiry Card



Counter & Recorder

Developed to count and permanently record screw machine production, system can be used to monitor the length of time each machine runs without bar stock, or conversely, the amount of time each machine runs while stocked and producing finished parts. If desired, the unit can also be set to record the number of counter impulses. In addition, the unit on the screw machine has its own counter which can be used to record either shift production or total job count.

In an installation on model 00 Brown & Sharpe machines, 14 serial counters are used to record only the production of full-length parts. Short-length parts, which normally occur at the end of the bar, are not counted by the unit. Alongside each counter is an electrical connector to which a time recorder may be attached in order to secure a written record of machine performance. The unit may also be equipped with an elapsed time meter that registers minutes and tenths of minutes. **Count-O-Larm Co.**, 1910 Elston Ave., Chicago, Ill.

Circle 475 on Inquiry Card

Readout Tube

Used in computer readout, industrial control, electronic instrumentation, military electronic control and channel selectors, all-electronic readout tube converts electronic signals directly to readable characters. It contains all the numeric digits, any one of which can be selected and displayed in a common viewing area. It can be triggered by beam switching tubes or any suitable voltage source requiring approximately ¼-watt.

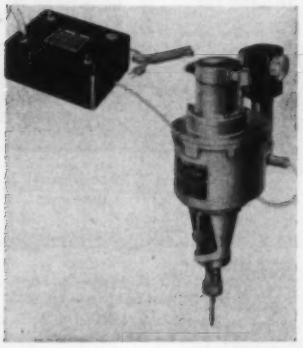
Called the Nixie, the unit features a design which provides a wide viewing angle and sharply defined digit contours. **Electronic Tube Div., Burroughs Corp.**, Plainfield, N. J.

Circle 476 on Inquiry Card

Automatic Tapping Head

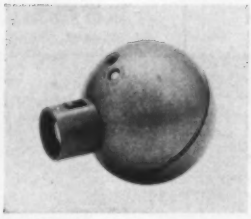
Developed to economically automate tapping even for the small shop, self-contained tapping head unit operates from a drill press or a direct motor hook-up. The three-way control box permits fingertip control, foot switch control or remote control setup for the fully automatic production line.

Called the Auto-Tap, the device has an adjustable depth control and reversing mechanism that is



activated by a relay. The built-in activating air motor requires low pressure air and is responsible for the sensitivity of the unit that assures repetitive accuracy and precision, avoiding tap breakage, reducing work spoilage and reducing operator fatigue. The tap range is 0-80 to ¾-10, up to a 2-inch stroke. **Automatic Methods Inc.,** 875 W. Grand St., Elizabeth, N. J.

Circle 477 on Inquiry Card

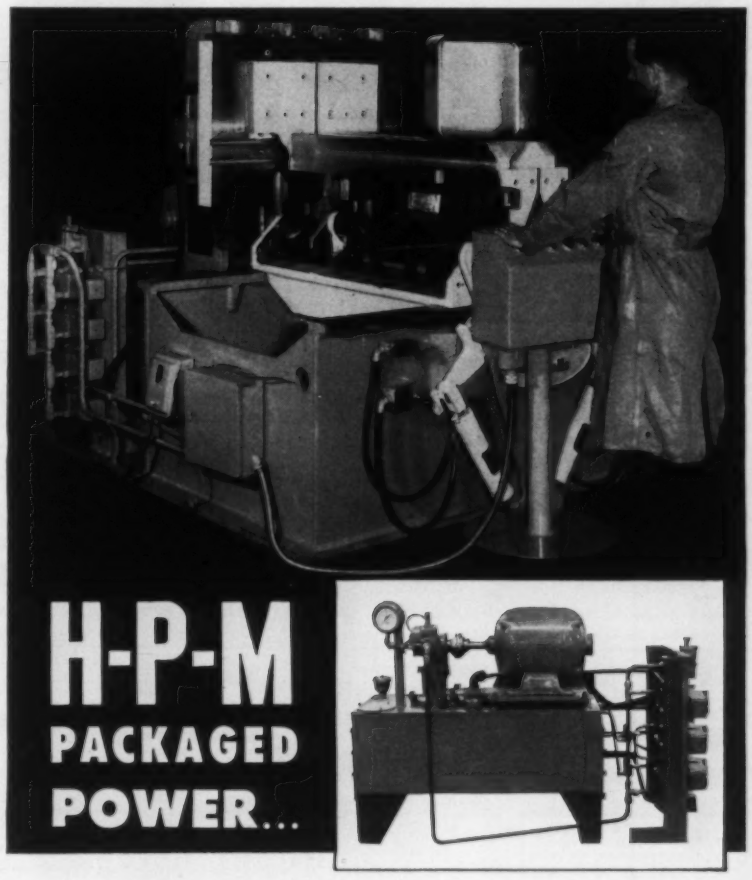


Electronic Eye

Used for photoelectric counting, remote control units for television, etc., self-contained checking-logging device features a nonmagnetic electrostrictive ceramic actuated relay known as the Capaswitch. The ceramic twitches to gap the relay points under an electric charge.

Operating components of the checker-logger are housed in a sphere 5 inches in diameter. A receiver sphere contains a lamp and transformer. All operating components on the receiver sphere are assembled in the top half which is removable and plugs in to facilitate servicing and maintaining the system. A calibrated sensitivity control, adjustable from outside the housing, provides for locating the spheres close together or far apart. **Basic Controls Co.,** 4350 S. Sepulveda Blvd., Culver City, Calif.

Circle 478 on Inquiry Card



as used by Struthers Wells

Struthers Wells Corporation, Titusville, Pennsylvania, manufacturers of quality bending machines, specify dependable H-P-M hydraulics for the smooth, positive action so important for metal bending operations. Here are the reasons: convenient off-the-floor design, easy access to all elements of the unit, compact solenoid operated valve panel system, easy-to-reach electric pushbutton controls and most important—dependable, job proved H-P-M components that provide solid satisfaction through years of service. You can rely on H-P-M—and recommend them for your OEM equipment. Send for complete catalog information, today.

HPM

HYDRAULIC POWER DIVISION

THE HYDRAULIC PRESS MFG. CO.

Mount Gilead, Ohio, U.S.A.

A DIVISION OF KOEHRING COMPANY

1877—1957

Circle 605 on Inquiry Card

over 14,000 8,000 Different Cylinder SELECTIONS—

Miller

AIR AND HYDRAULIC

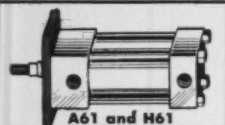
"STANDARDIZED" CYLINDERS

"IN STOCK" for immediate delivery...

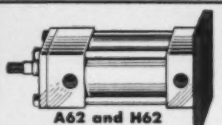
See Miller Bulletins A-105 (Air) and H-104 (Hydraulic) for Complete Dimensions and Engineering Data on these standardized "in stock" sizes and other Custom Miller Cylinders in bores up to 20" and strokes up to 22 ft.

"IN-STOCK" MODELS

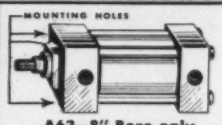
"A" Signifies Miller 200 psi Air Cylinders; "H", 2000 psi Hydraulic Cylinders. Interchangeable Mountings Are Shown In Red On Drawings.



A61 and H61
Flange Mounting on Rod End
(A61 not available in 8" bore)

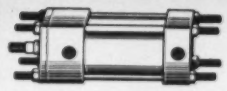


A62 and H62
Flange Mounting on Cap End
(A62 not available in 8" bore)

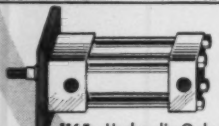


A63—8" Bore only
Flange Mounting on Rod End

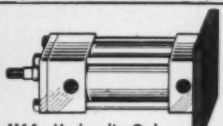
A64—8" Bore only
Flange Mounting on Cap End



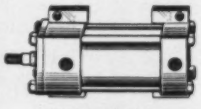
A50 & H50—Tie Rods not extended beyond nuts.
A51 & H51—Tie Rods extended both ends (shown).
A52 & H52—Tie Rods extended. Cap End only.
A53 & H53—Tie Rods Extended. Rod End only.
A54 & H54—Two Tie Rods extended at both ends.



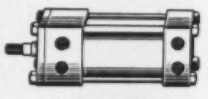
H65—Hydraulic Only
Flange Mounting on Rod End



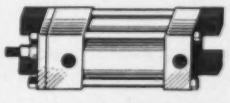
H66—Hydraulic Only
Flange Mounting on Cap End



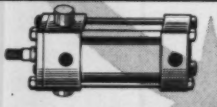
A72 and H72
Side Lug Mounting



A74 and H74
Side Flush Mounting

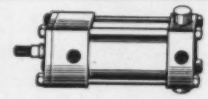


A77 and H77
Side or Foot Mounting

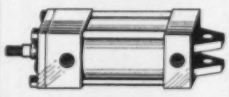


A81 and H81 Trunnion Mounting on Rod End

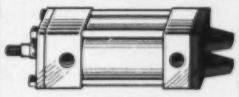
Your Choice of
CAP END CUSHIONED
ROD END CUSHIONED
or
BOTH ENDS CUSHIONED
on all cushioned strokes of all bores shown.



A82 and H82 Trunnion Mounting on Cap End



A84 and H84
Pivot Mounting



A86 and H86
Pivot Mounting

IN STOCK BORES In Inches

"IN-STOCK" STROKES (in Inches)

	Bores	Rod Dia.	Rod Turn Down & Threads		1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
AIR	1½	⅝"	7/16-20	Cushioned			3	4	5	6	7	8	9	10	11	12									
				Non-Cush.	1	2	3	4	5	6	7	8	9	10	11	12									
	2	⅝"	7/16-20	Cushioned			3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
				Non-Cush.	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
	2½	⅝"	7/16-20	Cushioned			3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
				Non-Cush.	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
	3¼	1"	¾-16	Cushioned			3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
				Non-Cush.	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
	4	1"	¾-16	Cushioned			3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
				Non-Cush.	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
	5	1"	¾-16	Cushioned			3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
				Non-Cush.	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
	6	1⅜"	1-14	Cushioned			3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
				Non-Cush.	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
	8	1⅜"	1-14	Cushioned			3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
				Non-Cush.	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
HYDRAULIC	1½	⅝"	7/16-20	Cushioned			3	4	5	6	7	8	9	10	11	12									
				Non-Cush.	1	2	3	4	5	6	7	8	9	10	11	12									
	2	1"	¾-16	Cushioned			3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
				Non-Cush.	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
	2½	1"	¾-16	Cushioned			3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
				Non-Cush.	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
	3¼	1⅜"	1-14	Cushioned			3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
				Non-Cush.	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
	4	1¾"	1¼-12	Cushioned			3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
				Non-Cush.	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
	5	2"	1½-12	Cushioned			3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36
				Non-Cush.	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	24	28	32	36

(1) "A" and "H" Models 82, 84 and 86 with strokes over 18" require stop tubes.

Column strength requires larger diameter piston rods for the following:

Air Cylinder Models A82, 84, and 86 with strokes inside area (1), when operated at 100 psi and over;

All hydraulic models with strokes inside area (2) and Models H82, 84, and 86 with strokes in area (4), when operated at 2000 psi and over;

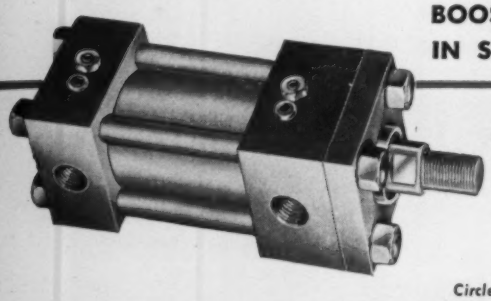
Models H82, 84 and 86 with strokes inside area (3), when operated at 1000 psi and over.

Depending upon Trunnion Pin location, "A" and "H" Models 83 with standard diameter piston rods can have longer strokes than Models 82, 84 and 86.

See Miller File #251 for oversize piston rod and stop tube requirements.

BOOSTERS IN STOCK

Immediate Delivery on the following Miller 25 to 1 Ratio Boosters (80 psi air input produces 2000 psi hydraulic oil output): Model B4, 5" bore, 1" dia. ram, 6" and 12" strokes; Reciprocating Booster Model DA77-RBA8, 5" bore, 1" dia. ram, 6" stroke. Also Booster Tanks, 5" dia., 6" and 10" heights.



Write For Catalog and Stock Price List

Miller

Miller FLUID POWER DIVISION
Flick-Reedy Corp

2015 N. Hawthorne Ave., Melrose Park, Ill.

AIR & HYDRAULIC CYLINDERS • BOOSTERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS

Circle 606 on Inquiry Card

catalogs and literature

Latest automation information. For copies use card page 17.

Voltage Stabilization

General Electric Co., Schenectady 5, N.Y.—16-*page booklet*—Electrical and electronic equipment has more efficient performance and longer service life when supplied with stable voltage such as availabe from voltage stabilizing transformers discussed in booklet BEA-5754C. Operating principles and advantages of GE units are illustrated and discussed. Standard single-phase units rated from 15 to 10,000 va are described. Ways to adapt standard units to special applications are explained.

Circle 479 on Inquiry Card

Weigh Batching

Fairbanks-Morse & Co., Fairbanks-Morse Bldg., Chicago 5, Ill.—8-*page bulletin*—Electronic program control as applied to weigh batching is discussed in Bulletin ED-15. In accordance with prepunched instructions on a card, the EPC system provides automatic control of ingredient selection, weighing of ingredients, batch discharge and mixing or blending. Photographs illustrate control console sections, and functions of each are described.

Circle 480 on Inquiry Card

Industrial Annunciator Systems

Scam Instrument Corp., 1811 *W. Irving Park, Chicago* 13, *Ill.*—20-*page booklet*—Continuous supervision of control systems and machinery is provided by line of self-policing annunciator systems described in booklet. General and special purpose systems for visual and audible alarms are illustrated and discussed. Information on proper selection of such systems, wiring diagrams, and sample alarm sequences are included.

Circle 481 on Inquiry Card

Miniaturized Meter-Relays

Assembly Products Inc., Chesterland 9, *O.*—12-*page bulletin*—Used in control applications where controlled variables can be represented by voltages or currents, line of relays and compacts (meter-relay, load relay and other control components in one package) is the subject of Bulletin 104. Both ac and dc meter-relays, interrupters, power supplies and load relays are illustrated and described. Descriptions and diagrams of circuits are also given.

Circle 482 on Inquiry Card

Toggle Headers

Waterbury Farrel Foundry & Machine Co., Waterbury, Conn.—8-*page bulletin*—Used for upsetting heads on screw and rivet blanks and forming tubular rivet blanks, line of toggle headers producing two blows per cycle is discussed in Circular No. 854-A-4. Operation, feed mechanism and adjustment, cutoff with automatic safety slip device, blank transfer, punch shifter, punch adjustment blank knockout, and motor drive of the header are covered. Toggle transfer headers which are used for cold heading blanks requiring four blows or three blows and a trimming operation are also described.

Circle 483 on Inquiry Card

Automatic Moisture Removal

Kathabar Air Conditioning & Drying Div., Surface Combustion Corp., Toledo 1, *O.*—8-*page bulletin*—High speed, low temperature dryer which is used for the automatic drying of chemicals, dairy products, foods, pharmaceuticals, etc., is the subject of illustrated bulletin. Photographs show several sections of the drying equipment. Brief descriptions of the operating principles of the dryer are also included.

Circle 484 on Inquiry Card

Instrumentation Index

Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, *Pa.*—24-*page catalog*—Bulletin G-2 lists company product catalogs and bulletins, specification sheets, bulletins on instrumentation technology, and general and specific application literature. Also included is a listing of Industrial and Valve Div. literature, and an index of subjects and companies covered by articles over the last ten years in *Instrumentation*, the company magazine.

Circle 485 on Inquiry Card

Valve-in-Head Cylinder

A. K. Allen Co., 57 Meserole Ave., Brooklyn 22, *N. Y.*—9-*page bulletin*—Model SVS single-solenoid valve-in-head cylinder is the subject of collection of pamphlets. Solenoid controls the movement of the cylinder rod when air is brought to the single port on the unit. Photographs, price list and specification data are included.

Circle 486 on Inquiry Card

Multiple Rotary Slitting Lines

Yoder Co., 5500 *Walworth Ave., Cleveland* 2, *O.*—76-*page catalog*—Divided into two sections, comprehensive catalog discusses various types of slitters and allied equipment. Part I includes data on design, selection and operation of slitters and slitting lines, including time studies and analysis of operating cycles. Part II covers specifications, capacity tables and other data on slitters, uncoilers, recoilers, coil cars and scrap choppers.

Circle 487 on Inquiry Card

Reduced Speed Drives

Sterling Electric Motors Inc., 5401 *Telegraph Rd., Los Angeles* 22, *Calif.*—12-*page bulletin*—Integral gear motors, speed reducers with separate motors, and speed reducers alone are the three types of reduced speed drives described and illustrated in bulletin. Exploded photographs show design features of the speed reducers; factors in speed reducer selection are also covered.

Circle 488 on Inquiry Card

Automatic Control Components

Automatic Temperature Control Co. Inc., 5200 *Pulaski Ave., Philadelphia* 44, *Pa.*—20-*page booklet*—Line of company products designed for machine or process control is covered in booklet D-31. Products covered include: Differential transformer systems, automatic control systems, time controls, motorized valves, standard valves, counters, and electronic contactors. Photographs of instruments and devices and discussion of their applications are included.

Circle 489 on Inquiry Card

Meters and Controls

Bailey Meter Co., 1050 *Ivanhoe Rd., Cleveland* 10, *O.—8-page bulletin*—More than 100 measuring, transmitting, receiving, recording and indicating instruments and control components for power and process applications are described in Bulletin G15-1. Instrument and control applications are briefly discussed. Detailed literature reference for each product is included.

Circle 490 on Inquiry Card

Compacting Presses

F. J. Stokes Corp., 5500 *Tabor Rd., Philadelphia* 20, *Pa.—24-page catalog*—Used for making products ranging from tiny ferrite rings to large ceramic parts, line of industrial compacting presses is the subject of Catalog No. 816. Presses range in capacity from five up to 4000 pieces per minute and are fully automatic in operation. Photographs and descriptions of 25 models, including single punch and rotary type, are included.

Circle 491 on Inquiry Card

Readout Counters

Veeder-Root Inc., Hartford 2, *Conn.* — 6-*page pamphlet* — Used for telemetering, data conversion and automatic control, line of counters offering visual and electrical readout is described in pamphlet. Each instrument in the line has a five-figure capacity and provides 100,000 circuit arrangements. Mechanically and electrically actuated models are illustrated. Completely automatic unit which is electrically actuated and has electric reset is also shown.

Circle 492 on Inquiry Card

Process Control Instruments

United States Gauge Div., American Machine & Metals Inc., Sellersville, Pa.—16-*page booklet*—Indicating pilots, transmitters and receiver gages are included in the line of pneumatic instruments for process control which is discussed in Catalog No. 505. Also illustrated is a 3½-inch scanning diaphragm receiving gage with a rotatable dial which permits the operator to rotate the dial to a common set point. Information on measuring elements for pressure and temperature applications is included.

Circle 493 on Inquiry Card

Electric Fork Truck

Lewis-Shepard Products Inc., Dept. R-29, Watertown, Mass. — 20-*page booklet*—Designed for simplified materials handling in production areas and warehouses, Model E electric fork truck is the subject of Catalog No. 32-1. Engineering features of the truck are illustrated and discussed. Section on special purpose attachments includes a brief description of each accessory, its application and a photograph.

Circle 494 on Inquiry Card

Automatic Metalworking

Jones & Lamson Machine Co., Springfield, Vt.—24-page catalog—Application photographs illustrate combination of automatic machine tools, automatic loading and unloading, intermachine transfer and automatic sequence control. Catalog No. 56 discusses complete line of metalworking equipment which includes automatic thread and form grinders, automatic lathes, threading dies and holders, ram and saddle type turret lathes, and optical comparators. Photographs and brief descriptions of all models are given.

Circle 495 on Inquiry Card

Vinyl Plastic Hose

Hofmann Engineering Co., 5601 *S. Crawford Ave., Chicago* 29, *Ill.*—8-*page bulletin*—Designed for pneumatic and hydraulic applications with working pressures up to 124 psi, H-52 vinyl plastic hose is illustrated in bulletin. Hose uses include production air tools, air motors, air cylinders and valves, automatic machines, drill presses, riveters and air clutches. Bulletin also describes filter, regulator and lubricator assembly, and has photographs and specifications of hose fittings and adapters, hose clamp and ferrule type fittings.

Circle 496 on Inquiry Card

Screw Feeding

Pneuma-Serve Inc., P.O. Box 1025, *Cleveland* 2, *O.—37-page catalog*—Automated system of screw feeding is the subject of catalog which is comprised of pamphlets, transparency, photographs and photostats concerning screw feeding device. Complete feeder includes driving head, filter, line lubricator, gage and plastic hoses. Driving head is supplied with an adaptor for attachment to most standard drivers, a standard bit and bit extension.

Circle 497 on Inquiry Card

Tape Converters

Remington Rand Univac, Div., Sperry Rand Corp., 315 *Fourth Ave., New York* 10, *N.Y.*—8-*page bulletin* —Two electronic devices, the perforated-to-magnetic (PTM) tape converter and the magnetic-to-perforated MTP tape converter, are described and illustrated in bulletin. The PTM unit reads perforated paper tape and records the information on Univac magnetic tape. The MTP reads magnetic tape and punches the information on paper tape. Illustrations of systems and their components are included.

Circle 498 on Inquiry Card

Adjustable Speed Drives

Lewellen Mfg. Co., Columbus, Ind. —18-*page booklet* —Using adjustable or variable pulleys, belts and adjustable bases, variable speed drives and their components are the subject of Catalog No. 60B. Drive is available with automatic control to change speeds without stopping the machine. Application photographs, dimensions and rating data are included.

Circle 499 on Inquiry Card

Tube Fabricating Equipment

Tube & Hose Fittings Div., Parker Appliance Co., 17325 *Euclid Ave., Cleveland* 12, *O.—24-page catalog*—Bench mounted benders, power flarers, straight thread tapping and counterboring tools are included in the line of tube fabricating equipment discussed in Catalog No. 1140. Hand tools such as tube cutters, flarers and benders are also illustrated and described.

Circle 500 on Inquiry Card

Power Lubrication

Lincoln Engineering Co., Div., McNeil Machine & Engineering Co., 5794 *Natural Bridge Ave., St. Louis* 20, *Mo.*—8-*page bulletin*—Engineered for positive, reliable lubrication of automated machine groups or components, centralized systems are the subject of Bulletin No. 811. Systems consist of a pneumatic power driven lubricant pump with a self-contained lubricant reservoir, or provision for receiving lubrication automatically from a pumping station remotely located. Units can be controlled either mechanically, electrically or manually. Typical installation photos and a discussion of available types of pumping units are included.

Circle 501 on Inquiry Card

Automatic Gaging Equipment

Moore Products Co., H & Lycoming Sts., Philadelphia 24, *Pa.*—26-*page catalog*—Used for quality control applications, line of air gages is described in Bulletin 8004. Automatic sorting equipment illustrated includes a pneumatic gage, precision relay and pneumatic feeding mechanism. Several types of air gages are illustrated and discussed; calibration charts, specifications of pneumatic plugs and rings and accessory data are included.

Circle 502 on Inquiry Card

Business Forms

Moore Business Forms Inc., Niagara Falls, N. Y.—18-*page booklet*—Basic requirements for nine key operations of a business—purchasing, receiving, stockkeeping, production, selling, delivery, billing, collecting and disbursing—are discussed in illustrated booklet. Material is presented as a guide so that present

or planned forms can be checked for completeness of information and efficiency of work flow.

Circle 503 on Inquiry Card

Directional Control Valves

Oilgear Co., 1585*D W. Pierce St., Milwaukee* 4, *Wis.*—16-*page booklet*—Used for fluid power systems up to 3000 psi, three and four-way directional control valves are covered in Bulletin 80300. Manually, mechanically, hydraulically, and solenoid-pilot operated models are described and illustrated. Type designation charts are given for each model; photographs illustrate custom built valves for special applications.

Circle 504 on Inquiry Card

Hose Assemblies & Fittings

Stratoflex Inc., P.O. Box 10398, *Fort Worth, Tex.*—12-*page bulletin*—Line of industrial hose whose range of uses includes hydraulics, air, water, fuels, hot oil, gasoline, butane-propane, antifreeze, etc., is illustrated and described in bulletin. Several types of hose and hose fittings are shown, along with specifications. Data on hose assembly adapters is also given.

Circle 505 on Inquiry Card

Strip Edge Control

Askania Regulator Co., 240 *E. Ontario St., Chicago* 11, *Ill.*—8-*page bulletin*—Designed to hold the lateral position of strip traveling up to 5000 fpm, edge control for strip steel is the subject of Bulletin 33.1. Illustrations and descriptions of models available for light and heavy duty at slow, medium or high speeds plus application, operational and installation information are given.

Circle 506 on Inquiry Card

Automatic Welders

National Electric Welding Machines Co., 1846 *Trumbull St., Bay City, Mich.* — 6-*page pamphlet* — Featuring automatic feeds, positioners and discharge devices, and multihead design, production arc welding machines are discussed in Vol. 10, No. 4 of Welding News. Eight application photographs of various machines are included, along with a brief description of the operating characteristics of each.

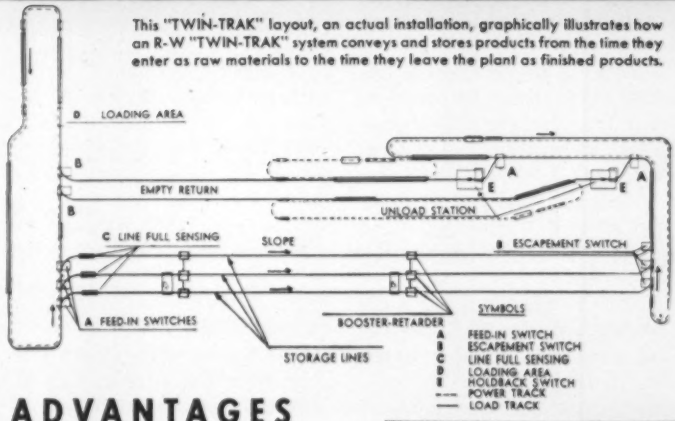
Circle 507 on Inquiry Card

Compact Controller

Engineering Div., Swiss Colony, Monroe, Wis.—4-*page pamphlet* — Problems of sensitive control such as with pressure, vacuum, temperature, liquid level, flow, or condensate drainage are solved by electronic-hydraulic control unit described in pamphlet. Photographs illustrate the units which combine fast electronic sensing and hydraulic actuation.

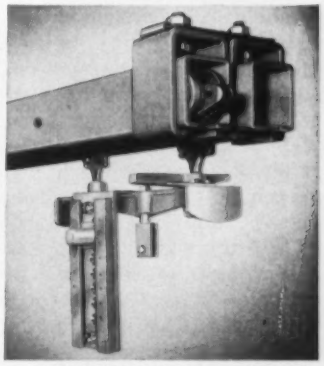
Circle 508 on Inquiry Card

This "TWIN-TRAK" layout, an actual installation, graphically illustrates how an R-W "TWIN-TRAK" system conveys and stores products from the time they enter as raw materials to the time they leave the plant as finished products.



ADVANTAGES

- Provides trouble-free, automotive-selective control over product movement through entire plant.
- Economical and practical . . . provides added storage space . . . saves time, labor and money.
- Automatically supplies component parts to work stations from storage banks or lines.
- Economical to install . . . extremely flexible . . . quickly and economically revised or modified to meet your changing needs or future expansion plans.
- Ideal for conveying and dispatching products in multiple story buildings.
- Designed, manufactured and backed by the leading firm in this field for over 75 years.



An R-W "TWIN-TRAK" System consists of one or more power tracks and as many storage or free tracks as desired. Available with efficient, economical manual or electronic selective controls designed to effectively meet your specific requirements.

WRITE TODAY

for complete information . . . request Catalog F-192.

Leading manufacturer of Track Hangers, all types of hardware and Electric Door Operators for over 75 years.

Richards-Wilcox
MANUFACTURING COMPANY
Materials Handling Division

417 W. THIRD STREET, AURORA, ILLINOIS • Branches in Principal Cities

Circle 607 on Inquiry Card

AUTOMATION abstracts

MACHINE PRODUCTION OF TRANSFORMERS

By W. BRACKMANN, R. LEVINSOHN and D. McCARTHY
American Machine & Foundry Co.
Greenwich, Conn.

MECHANIZED manufacture of transformers has lagged far behind that of capacitors, resistors, tubes and other electrical system components. A major obstacle has been the requirement for extracting leads from certain points within the coil, an operation made most difficult by conventional coil design. However, present effort is directed toward eliminating hand production methods where economically justified.

The American Machine & Foundry Company's General Engineering Laboratories, under contract to the U. S. Air Force's Air Materiel Command with technical support of Wright Air Development Center, is presently engaged in the design and development of a mechanized wafer transformer production line, for inductor, power, audio, and pulse-transformers up to one-quarter kva. The wafer type of construction facilitates mechanization of transformer production. The coil in a wafer transformer is built of pies rather than layers. Each pie (wafer) is a winding formed by a ribbon slit from insulated aluminum or copper foil. The wafer terminals may readily be located as the wafers are assembled into windings and coils. The use of ribbon in larger transformers is not new in the art and commercial use of considerable numbers of wafer transformers has been reported.

Machine-produced transformers must, first of all, equal the standard products of the trade in performance and reliability. This could be accomplished by a direct mechanization of the existing fabrication and assembly processes, but design and machinery costs would be prohibitive. Wafer construction—using foil—is more practical.

Basically, the use of foil is more attractive because it lends itself to simpler fabrication than wire. Aluminum, in particular, offers about 260 micromhos conductivity per dollar compared to copper's 68 (base price comparison) and is available as a less-critical metal in a wide choice of gages. Thin copper is currently becoming more available as new uses are being made known. Since aluminum foil and aluminum laminated to various non-conductors are standard commodities, there is no reason, other than the present limited demand, to prevent a similar availability of equivalent coating and laminates in copper. An estimated cost comparison of insulated foil ribbon with insulated wire appears favorable.

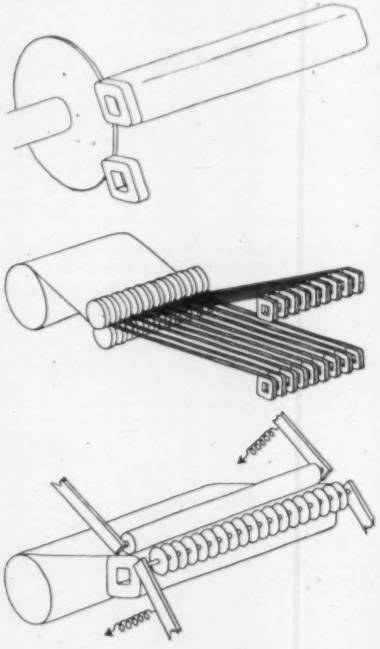


Fig. 1—Basic forms of wafer production.

Wafer Production

A product analysis of the wafer producing process has shown at least twenty different methods for producing an electrically satisfactory wafer. In general the methods may be classified into two divisions: those that attach the leads before winding and those that attach after winding.

Three methods of producing a wafer have been intensively investigated and are shown in *Fig.* 1. The first, wind-slice, is accomplished by winding foil and insulation into a roll and slicing off wafers of desired width. In the wind-slice method, wide foil of any thickness can be used and it may be coated, laminated or interwound with a great variety of insulations. The terminal socket is attached to the foil before winding. This attachment can take many forms, but whatever form the primary attachment takes, it must be held within the confines of the future wafer. This requirement means that the machine must be capable of going to the inside of the wafer to locate and attach extension lead(s) during subsequent operations. After attaching the inside tab, the foil is wound into a roll and the outer tab is applied. It is important that the roll be made as rigid as possible to facilitate slicing. This rigidity may be accomplished by vacuum impregnation, pressure sealing coatings, heat sealing, or by polymerizing layers on the foil. From the machinery standpoint, thermally converted coating seems most promis-

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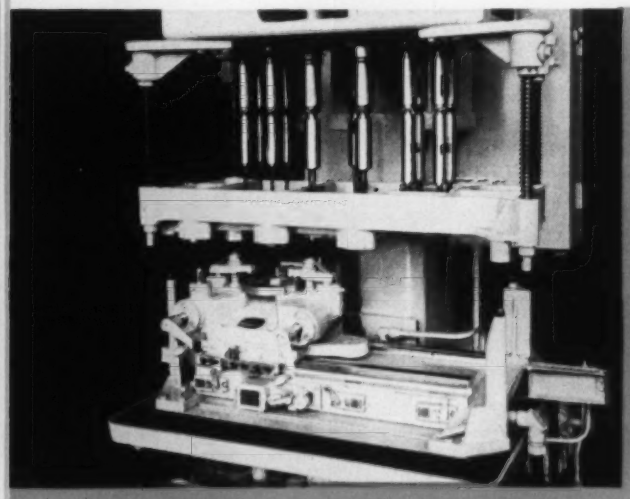
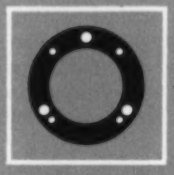
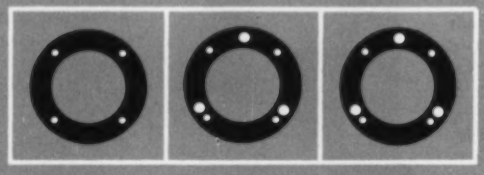


Multiple Drilling Operations on One Part-Face

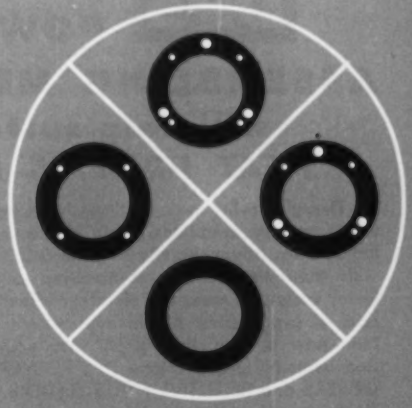
Straight-line indexing *on a Natco H6 produces 49 parts per hour. 4 holes drilled in first position, 3 holes drilled in second position, 4 holes c'bored in third position. One part completed every three strokes. Automatic cycling frees operator for other work. Illustrations below show three other ways of handling this part.*



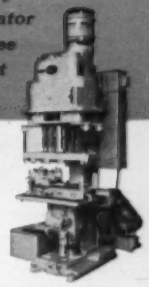
45 parts per hour. *Inexpensive box jig. Operator positions jig under appropriate spindles. One complete part for 3 strokes of machine.*



75 parts per hour. *3-position fixture. Operator shifts parts after each stroke. One part completed every stroke.*



155 parts per hour. *Rotary 4-position index table. Operator unloads and loads while three operations proceed. One part completed every stroke.*



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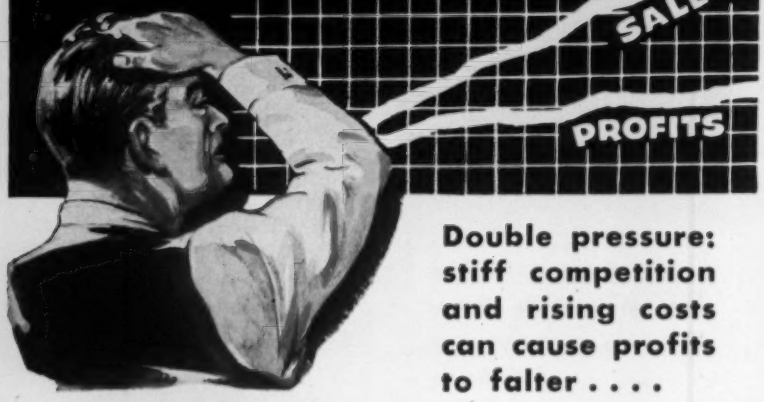

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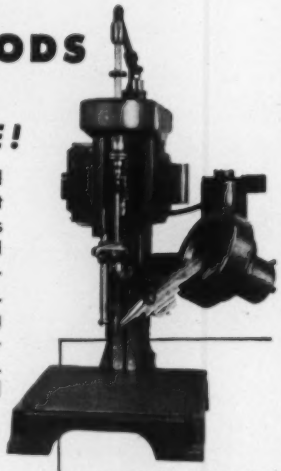

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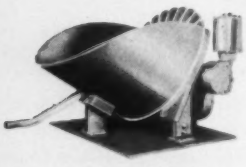

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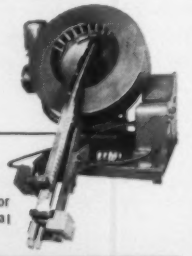

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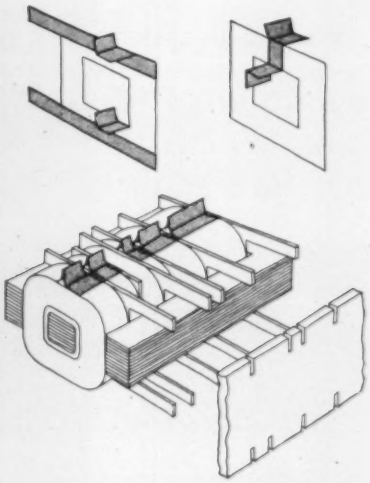

Fig. 2—Method of using terminal cards in combining wafers into transformer assemblies.

ing.

The major disadvantage of slicing is the tendency of the knife to smear the metal shorting the wafer. This shorting can be eliminated by chemical or mechanical means. Removal of the metal smear by chemical etch is by no means foolproof. In the fine wire sizes, the varying effect of acid attack on the edge of the wire can give significant variation in the width of the conductor. Also any acid which might penetrate between the insulation and foil must be completely removed during rinsing or the life of the wafer will be significantly affected. A technique for slicing wafers without shorting turns is undergoing trial. Using the wind-slice method, very fine wire wafers can be produced with a minimum of machinery.

The basic process for the second technique, wind-slit, is similar to that in wind-slice. Wind-slit, however, offers one important advantage in that it eliminates the smeared edges of the wafer. In this method, the foil and insulation are wound into a roll as in wind-slice, but, before the foil has completed one full turn, it is slit by a rotary blade which is positioned to extend into the roll for a depth of only a few layers. The resultant cut greatly reduces the tendency of the foil edges to smear. A whole arbor full of separate wafers may be wound simultaneously.

Although wind-slit eliminates the smeared edges, it does not entirely

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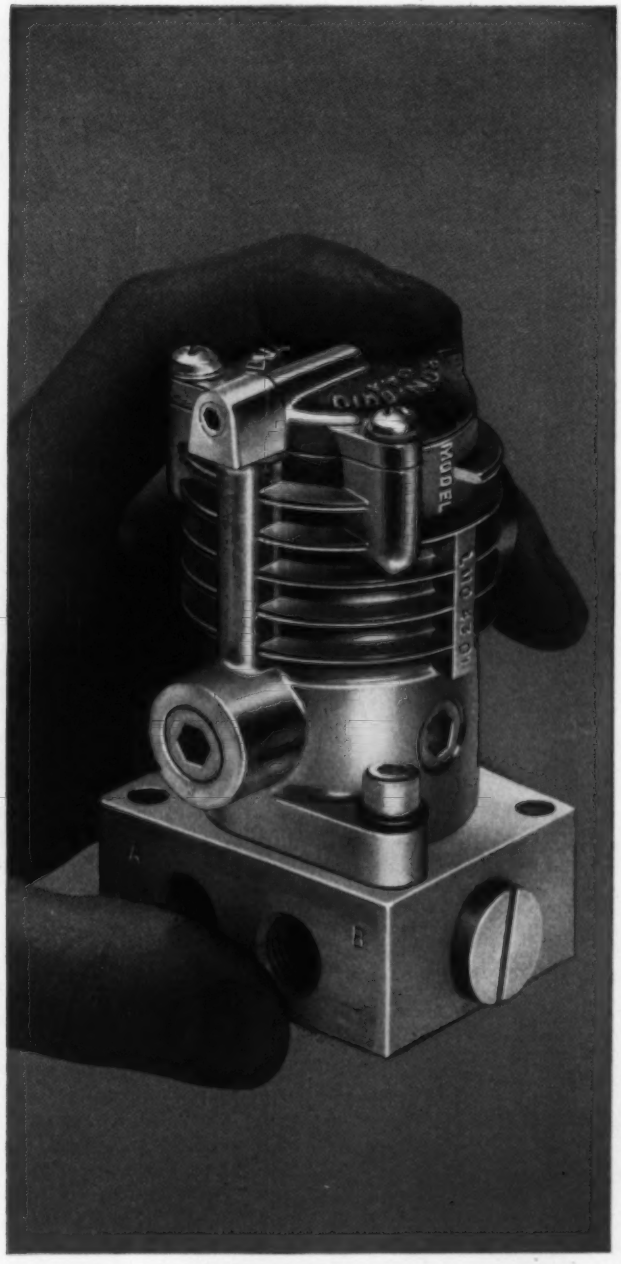

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2. USE OF STANDARD EQUIPMENT

• USING STANDARD EQUIPMENT—This primary approach to solving manufacturing automation problems will be thoroughly explored in this article. Standard equipment with available or specially-designed attachments and devices can solve many problems.

3. BUILDING BLOCK TECHNIQUE

• BUILDING BLOCK TECHNIQUE—The attributes and economies of this approach will be set forth for evaluation. To implement an automation program, semi-special machines often can be built-up through the "building block" technique.

4. SPECIAL PURPOSE LINES

• SPECIAL PURPOSE LINES—Special purpose lines generally involve a product where complete processing from raw materials to finished product is desired. This article will explain to AUTOMATION readers how to plan, design, and build such installations.

Remember the May issue of **AUTOMATION**

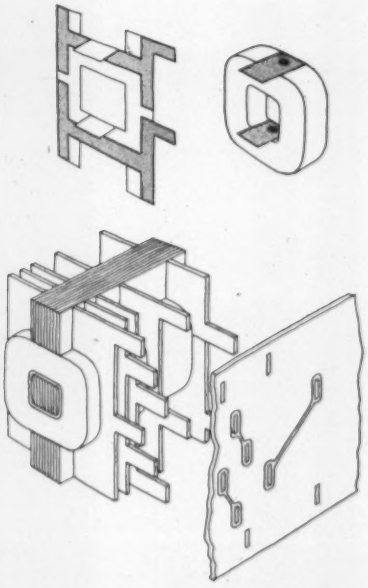

Fig. 3—Printed circuit terminal board can be used to interconnect wafers in a transformer assembly.

eliminate burrs and shorted turns. Therefore, some type of deburring is still required. The amount of etching required, however, is much less, more uniform, and therefore more easily controlled. This method can be employed to produce extremely thin wafers. Wind-slit has a higher production rate potential but is limited to foils under approximately 1 mil.

The third technique, slit-wind, is based on making insulated rectangular ribbon-wire before the wind operation. This makes it possible for the wafer terminal tabs to be attached to the foil ribbon before the wafer is rolled, thus it eliminates the undesirable process of attaching or pulling out leads within the rolled wafer.

The insulated foil is first slit into individual strands which are then ironed to orient the burrs within the plane of the foil. Several promising methods are being investigated for treating the individual strands to completely eliminate burrs and therefore the necessity for acid etching. The individual strands are then fanned out over a short distance to the terminal attachment station. At the station, the leads are ultrasonically welded to the foil strands. The attachment is programmed to attach the leads in a predetermined position where they are available for subsequent connection. An important advantage of this method

is that the leads can be applied at any intermediate tap points in the wafer winding.

After terminal attachment, the strands are fed to the winding arbor where the actual wafers are wound. Even when untreated, the thinnest wafers are surprisingly rugged but, they can be further strengthened by impregation or heat curing.

Laboratory production of wafers indicates that they should be bonded together turn to turn. When this is not done, a tightly wound wafer tends to buckle at the inner turns when it is removed from the arbor. Bonding of the wafer turns prevents this buckling. Also, when winding wafers from ribbons, a good deal of care must be taken to provide a ribbon which is perfectly flat; that is, the edges are not torn or deformed during the slitting operation or by the guides through which the ribbon passes. Burrs build up on the wafer as it is being wound, and the foil ribbon assumes a channel cross shape. The stress in the flanges of the channels becomes increasingly severe during the build-up of the wafer, until cracking occurs.

While considerable investigation of soldering methods for lead attachment has already been done, the influence of solder on aluminum foil life has indicated that the major emphasis should be directed toward welding methods. Resistance welding and pressure (cold) welding require the difficult operation of cleaning fine foil. Welding can be standardized for all temperature classes. Ultrasonic welding is being intensively studied since it provides a joining method which does not require cleaning of the foil prior to welding. Using this method, joints may even be made through insulation. Aluminum-to-aluminum, copper-to-copper, and aluminum-to-copper welds can be made in the finest foil gages.

Coil Production

Although many systems of manufacturing are possible for a two-terminal coil such as solenoid, relay, or certain transformer coils, these systems do not satisfy all transformer coil requirements. Mechanization for the industry at large calls for a system which

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would provide the leads for the wide variety of coils found in transformer manufacture.

The simplest type of wafer lead arrangement would be one in which the wound ribbon comes out directly to the terminal board or functions as a terminal itself. However, machinery which could achieve this for smaller wire sizes is not practical. The more reasonable design schemes involve the following four steps: preparation of the wafer for a flat lead; attachment of the flat lead; connection of the flat leads to each other to provide wafer interconnections; and finally, the adaptation of these flat leads directly as transformer terminals or connection of these flat leads to the transformer terminals attached to the case or mounting bracket.

Fig. 2 illustrates a terminal card. This card consists of a laminate of dielectric and suitably shaped copper foil terminals. Where a winding consists of a single wafer, the card would contain two independent foil sections. Tabs extend at right angles into the wafer body and continue beyond the periphery of the wafer to permit connection directly into the terminal board or into the component panel in which the transformer is to perform. The ends of the terminal card which protrude past the wafer may be stamped into stiffer shapes than that of the flat tab shown. In the case of a coil winding which requires several wafers, a series type terminal card is used. This connects the inside turn of one wafer to the outside turn of another.

This terminal system is less suitable for a transformer coil which is composed of very thin wafers. As illustrated in the transformer assembly in *Fig.* 2, the spacing between the outside card terminals is a function of wafer thickness. The obvious solution to this problem is to orient the outside card terminals 90 degrees to the core, as shown in *Fig.* 3. In this arrangement, the iron core of the transformer does not interfere, and it is possible to stagger the connections to the transformer terminals. The terminal card design thus becomes a more generalized version of the terminal card previously shown,

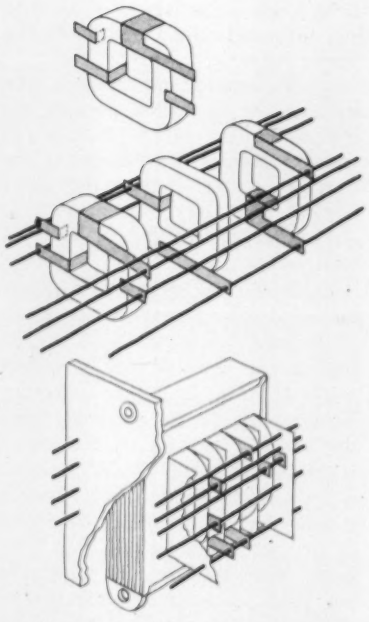


Fig. 4—Wire grid permits interconnection of standard wafer sizes in module system.

and the type of wafer shown represents an alternate method of preparing the wafers for connection to the terminal card. Wafer interconnections can be made either with series type of connection card or with a printed circuit terminal board as illustrated in *Fig.* 3. From the standpoint of automation, this system still contains several limitations. It is difficult to standardize a terminal board system, since the spacing between terminal tabs in one direction is dependent upon the wafer width which varies.

The terminal schemes in *Figs.* 2 and 3 utilize a simple wafer which is easily mechanized but requires a prepared terminal card. It is possible to eliminate the card by attaching the metal terminals directly to the wafer at the time it is wound. If this were done, a potential mechanized system would use only a two-terminal wafer. Every other wafer is reversed, so that connections are made from inside turn to inside turn and outside turn to outside turn.

The coil assembly can then be made by plugging all these wafers into a printed circuit terminal board or by using a grid of wires to connect the wafers to each other and to the terminal board, *Fig.* 4. This type of electronic packaging is very similar to the "tinkertoy" module system. The grid

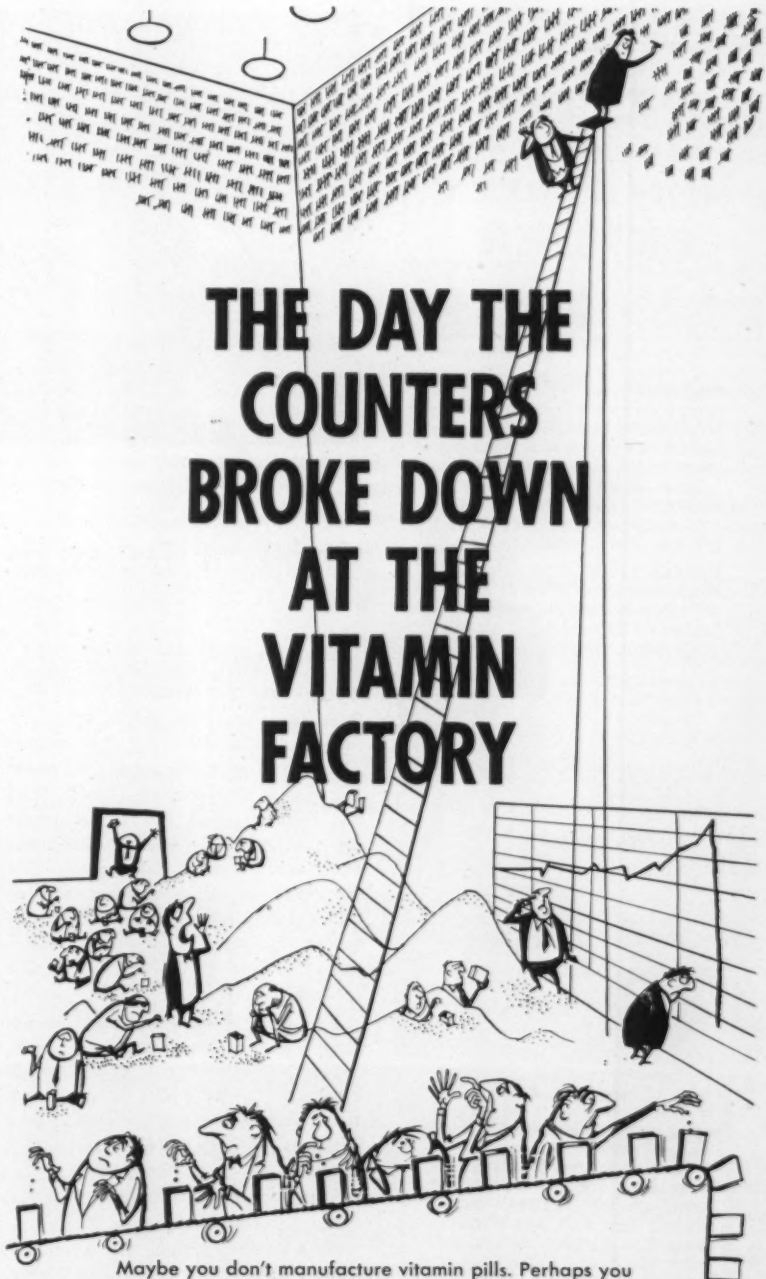
wires are on modular spacings, the spacing between the two rows being the major variant from transformer to transformer. This type of construction effects interconnection of the wafers, allows interleaving of primary and secondary windings, and easily brings out tapped wafer connections to the terminal board. The connection of the tab to the wires is accomplished by dip soldering methods. Variation in the width of wafers does not affect the configuration of the transformer terminal boards, and standardization is more easily obtained.

The operation of assembling the completed coil onto a core to produce an electrically-operative transformer, calls for a degree of mechanization which seems dependent on the specific needs of the individual transformer company. Study has shown that full mechanization can be provided if the volume of transformers justifies it. Varying degrees of semi-mechanization, which is actually the basis on which the industry operates today, may also be readily provided. In any degree, this semi-mechanized assembly would be advanced over the present production processes because of improved accessibility of the coil terminals.

Two basic methods for stacking an interleaved core have been examined. The first is based on the concept that the core might be stacked independently of the coil, the core then pivoted open, the coil inserted onto the center leg of the "E's", and the core again pivoted closed.

The second method of interleaving is based on the concept of inserting laminations alternately from opposite sides directly into the coil until the core is complete. This is essentially the method employed in presently available equipment. Several new techniques, which reduce jamming, were incorporated into this approach. It appears likely that this method is most adaptable for use with the production equipment.

From a paper entitled, "Basic Considerations in Foil Transformer Production" presented at the Radio Fall Meeting of the Radio-Electronics-Television Manufacturers Association, Syracuse, New York, Oct. 1956.



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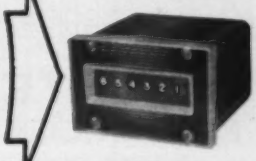

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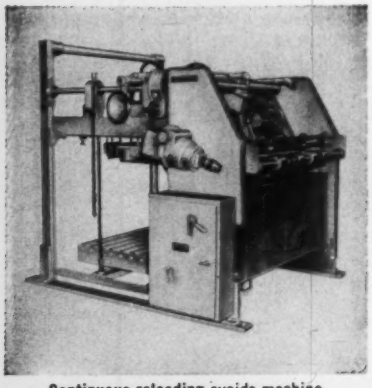

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Fig. 1—Potentiometer checker automatically measures potentiometer resistance, functions, hi-pot and noise. The machine cycles one test per second as programed by punched cards.

AUTOMATIC TESTING OF JOB-LOTS

By R. K. McDEVITT
Mgr. of Mfg., Air Arm Div.
Westinghouse Electric Corp.

AUTOMATIC test equipment installed at the Westinghouse Air Arm Div. has resulted in more efficient use of labor in two ways: (1) scarce technicians are released for more challenging work that requires a great degree of intelligence; and (2) semiskilled labor is more readily employed. The situation is one wherein skilled labor produces and services automatic equipment, permitting semiskilled labor to perform complex testing.

In addition, mechanization shortened the manufacturing cycle, thereby permitting a reduction in normal schedules and inventories. Of major importance, reliability of military products has improved, because the additional tests performed are not normally conducted through manual operation.

The Westinghouse Air Arm Div. builds fixed fire control systems, flexible fire control systems, missile systems, and special systems. Accumulated production quotas generally average less than 100 systems in one month, plus small quantities of spares and test equipment to render field support to these vital military products. Actually, five different airborne products are being produced, and, although similar in some respects, each presents its own peculiar manufacturing problems.

This can be pointed to as a job-shop type of operation further emphasized by constant engineering changes, creating hundreds of "stop and go" situations.

During the early planning stage, a manufacturing engineering department and a test equipment section were established. As part of the original study, it was found that test hours comprised 30 per cent of the total hours required to produce a system, using traditional methods of testing. It therefore became evident that this was the main area in which concentrated effort was needed to achieve real progress in cost reduction.

A special planning committee, composed of test engineers and manufacturing engineers, was immediately organized. This group was charged with the responsibility to study the feasibility and economics of automatic test equipment. The test engineers recognized that high number of test hours involved a considerable number of hand adjustments, and some were even two-man operations. They also recognized that a new approach to the problems had to be taken. They determined the high activity and the high labor areas in terms of expected production. They then assigned a set of reduction goals to achieve on a specific contract.

The primary objective had to be a reduction of job content as it affected the operator, transferring the responsibility for decisions,

judgment, and mechanical skills from the operator to the machine.

The study then became concentrated on the operations that could conceivably be transferred by mechanization of test equipment and still be justified economically. Included were: (1) high volume repetitive testing with small variations of parameters, such as transformer testing; and (2) low volume repetitive sequential testing demanding large variations of parameters, computer testing being a good example.

A chart breaking down the test operations throughout the plant was made. Progress could only be attained in the five basic operational areas of: (1) component testing at incoming inspection and transformer manufacturing; (2) wiring-harness checkout at the assembly stages; (3) unit and subassembly testing; (4) major assembly testing; and (5) composite testing.

Next a resistor capacitor bridge was introduced to perform receiving inspection tests on incoming components. This device measured and sorted the items as a function of tolerance, representing automatic handling and sorting.

Simultaneously, preliminary investigations were conducted on transformer testing. Development was started on automatic equipment which would check the proper transformer turns-ratio. It would involve quantity handling through programing, sequence testing and read out.

A parallel phase of investigation of automatic circuit check equipment was started. After the market was surveyed, cable harness automatic circuit checking equipment was applied. Quality of the cable harnesses quickly improved with the introduction of automatic hi-pot testing.

The next natural step of combining component and circuit checking on chassis was indicated. Advanced application engineering produced test stations where all preliminary testing of units was performed.

The next approach to automatic testing was to actually test electronic subassembly circuitry, such as: pre-amps, demodulators, resistor divider networks, etc. Again, the market was surveyed, but it soon became apparent that it was not economically feasible to apply any established equipment to special small molded unit packages. Thorough and concise development was started on a design for a special test set for this application.

Automatic assembly testing and semicomposite testing were then approached. Experience in subassembly testing was applicable in some instances. The principle of the automatic function checker was applied to various test stations. Experience on automatic component test stands led to a major effort on automatic programing of input parameters to a fire control system computer.

The remaining major job left was in the area of composite testing of fire control systems. This was accomplished by the application of microwave test mechanization. The encouraging results showed that the total test time on one type of fixed fire control system was reduced from 1000 hours to 200 hours.

An example of the automatic equipment is the potentiometer

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Model 461-C, 10-0-10 Ua DC $83.25

TRIP POINT ADJUSTABLE to any point of scale arc. Sensitive to changes as little as 1%. One contact on moving pointer. The other on adjustable pointer. When pointers meet, contacts close and lock. Holding coil wound on moving coil. Locking is electro-magnetic. Manual or automatic reset. Spring action kicks contacts apart.

Ranges: From 0-5 microamperes, 0-5 millivolts or 0-300°F up.

Standard Contact Rating 5 to 25 milliamperes DC. Can be up to 100 milliamperes DC.

Ruggedized-Sealed metal cases, 2½", 3½" or 4½" round, shock-mounted movement, gasket-sealed

Black bakelite case, 4½" rectangular.

Clear Plastic cases, 2½", 3¾" or 4½" rectangular.

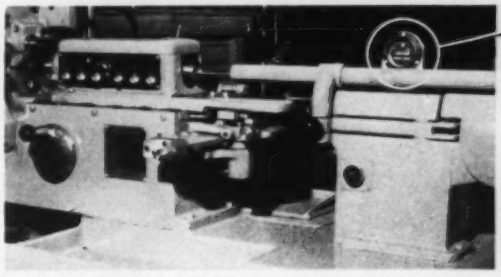
Model 255-C, 0-10 V DC $42.50

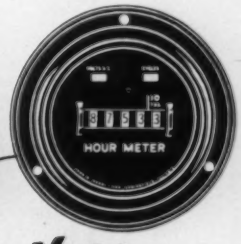
Panel meters and indicating pyrometers also in ruggedized-sealed, black bakelite or clear plastic cases. Write for new 40 page Catalog 4A on meter-relays, meters, pyrometers and automatic controls.

Assembly Products, Inc., Chesterland 27, Ohio. HAmilton 3-4436 (West Coast: P.O. Box XX, Palm Springs 27, Calif. Phone: DHS 4-3133.) Booth 1323, Design Engineering Show, May 20-23

Circle 616 on Inquiry Card

AUTOMATION REQUIRES GREATER EMPHASIS ON PROTECTIVE MAINTENANCE





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HOUR METERS
TAKE AWAY THE GUESSWORK!

The Hobbs AC Hour Meter indicates operating time of any machine or equipment powered by alternating current — basic time data essential in the study of utilization and production methods . . . and vital for protective maintenance programs. Wide range of applications — small, compact, easy to install. Ruggedly built and sealed against moisture and dust. Powered by an accurate synchronous motor specially designed for this instrument. Easy to read — tells at a glance accumulated time of operation to 10,000 hours, showing 1/10th hours. Also available in 100,000 hour models.

● **Ask your supplier . . . or write direct for Catalog AC-587 with complete information.**

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A DIVISION OF STEWART SW WARNER
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available to industry

Ready for quick shipment to you . . . Kellogg's top-quality Cam Keys. The T frame construction allows any number of spring combinations of either locking, restoring, or both locking and restoring type. These Cam Keys are rugged and withstand the most severe breakdown test of any key on the market.

Kellogg supplies industry with a top-quality line of keys, relays, jacks, plugs, and other components. Inquiries on quantity lots invited.

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QUALITY COMPONENTS FOR INDUSTRIAL CONTROL
QUALITY COMMUNICATIONS SYSTEMS

Circle 618 on Inquiry Card

checker, *Fig.* 1. It is a component testing device and represents the initial phase of our most complex endeavor in the automation field. The components tested are ganged precision potentiometers used in computers for fire control systems. An assembly of several potentiometers on a common shaft is called a gang. The individual potentiometer in such an assembly is called a cup. The measurements demanded are in the order of 50 checks of resistance to 0.05 per cent per exact angular position. This test is performed for each cup of a typically 5 to 13-cup gang.

The equipment application was developed around a high-volume item with a large range of parameters. The equipment will test a computing potentiometer gang for resistance, linearity of conformity, dielectric strength and electrical noise.

The resistance test presents three problems: (1) programing circuit connections among the six terminals of the potentiometer; (2) continuity checks; and (3) resistance measurements. A specially connected combination of stepping switches and mercury relays is used to accomplish a fixed program of switching among the potentiometer terminals. Continuity tests and resistance tests are accomplished by making voltage measurements between the selected terminals.

The function conformity test presents, in addition to voltage programing and measurement, the problem of accurate shaft positioning. This is accomplished by a special indexing device capable of indexing the shaft through 360 degrees in 7.5 degree increments at the rate of one increment per second. The great variety of function curves requires the use of an extremely flexible system of generating voltages corresponding to the various shaft angles. A punched card system controlling a set of digital voltage dividers is used to generate voltages accurate to 5 parts in 100,000.

The automatic machine operates on a fixed time base of one test operation per second through a sequence composed of a combination of fixed and variable switching programs. The one second time base is divided into three sections; setup, check, and test. The setup time is 0.6 second; the check time is 0.1 second; and the test time is 0.3 second. During the setup time, the necessary cards are fed and counted; the index mechanism is operated; the proper cup and test is selected; and the card is read. The setup switching sequence is a fixed program of switching variable only to the extent required to accommodate gangs of different numbers of cups. The resistance ranges and values, function values, and certain machine control and gang identification signals make up the variable program switching. These quantities are all programed from punched cards and can be varied, at will, from one second to the next.

The card information capacity in this application is twenty-four digit numbers plus control and identification signals. Some six cards are required to contain the test data necessary to test a single cup. Up to 84 cards are needed to completely test a 14-cup gang. A special stepping-switch card-reading circuit breaks each card down into ten test data zones to increase the information stored on each card.

Each deck of cards used is uniquely related to a particular potentiometer gang by a special hole pattern in each card of the deck. The machine identifies each card as to its presence or absence and determines whether it matches the gang cup, and test required for the particular test operation programed for that instant.

The machine indicates a deviation from specification requirements by a certain pattern of lights, giving the operator a "Go-No-Go" indication of failure. On tests where it is applicable, a direct read out of the magnitude of the error can be made by the operator.

The application of the potentiometer checker has speeded test time by a factor of 16 to 1. A labor saving of over 90 per cent resulted from this automatic test equipment.

From a paper entitled "Manufacturing Improvement Through Automatic Testing Techniques" presented by Westinghouse Electric Corp., Air Arm Div., Baltimore, Feb. 1957.

Series B Turret Index Model, with phantom view of typical mounting brackets, tooling.

START YOUR **AUTOMATION** PLANNING WITH

SWANSON

STANDARD INDEXING MACHINE CHASSIS

Save valuable engineering time and cut the cost of building your automatic and special purpose machines

You can get the benefits of automation *without making a large capital expenditure.* You can easily justify automation projects by building your special machinery around a Swanson standard chassis.

These versatile "packaged" units provide the basic chassis for a wide range of special purpose automatic machines. Because they eliminate much of the engineering and building formerly required, Swanson units lower costs and shorten completion time . . . considerably broadening the applications of automation.

Write for Bulletin 356-A. It describes the complete line of Swanson Standard Index Machine Chassis.

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CORPORATION
814 EAST EIGHTH ST., ERIE, PA.

ENGINEERS AND BUILDERS OF AUTOMATIC AND SPECIAL PURPOSE MACHINES SINCE 1919

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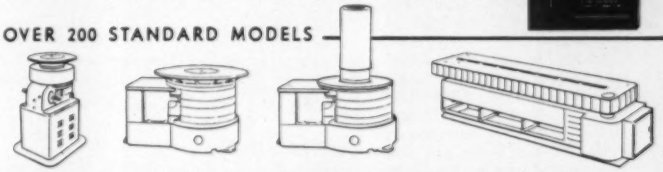

Series B & C Turret Index Models—for medium and light applications.

Series H Turret Index Models—for heavy duty applications.

Series K Turret Index Models—for heavy duty applications with center column tool mounting.

Series L Auto-Tran Straight Line Indexing Chassis—for automatic or semi-automatic assembly and processing operations.

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Write For 32 Page Catalog

- Pump Controls
- Duplex Pump Alternators
- High and Low Level Cutoffs
- High and Low Level Alarms
- Multi-level Signals
- Liquid Metering
- Special Controls and Panels

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Warrick

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LIQUID LEVEL CONTROLS
ELECTRODE TYPE

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-wheel • -gravity roller • -live roller

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Made with NYLON wheels and bearings and with galvanized steel rollers with NYLON bearings. Steel or aluminum frames.

EFFICIENT FOR-: Wet conditions, Salt, Abrasives, Fruit and Dairy Acids, many Industrial Acids.

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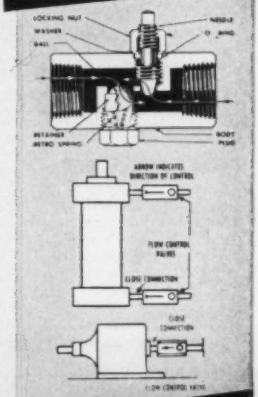
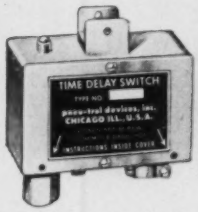
For Precise SPEED and TIME DELAY CONTROL OF AIR OR HYDRAULIC CYLINDERS

use Pneu-trol VALVES and TIME DELAY CONTROL SWITCHES

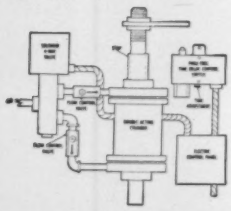
Pneu-Trol Valves combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to seat, requiring only a slight differential pressure to fully open or close it. Check valves and needle valves, incorporating single function features of Flow Control Valve are also available. All valves made in 5 female pipe sizes: ⅛" to ¾". Valve bodies made from brass, aluminum, steel or stainless steel.



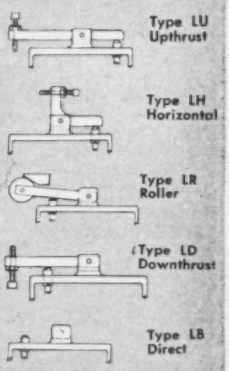
TIME DELAY CONTROL SWITCH FOR PRECISE DELAY OF WORK CYCLE



Provide controlled adjustable time dwell of solenoid operated air or oil supply valves. Range between ¼ and 60 seconds in 20 to 1 ratios. Compact—simple—foolproof—rugged Easily mounted on machine. Available for various types of actuation. Typical diagram below.



For Any Type Actuation Left or Right Hand (Left Hand Shown)



Write for catalogs and complete details

Pneu-trol DEVICES, INC.
Components for Automation
1420 N. Keating Ave., Chicago 51, Ill.

AUTOMATION patents

Copies of patents are available at 25 cents each from the Commissioner of Patents, Washington 25, D. C.

METHOD AND APPARATUS FOR SPOT COATING BOX BLANKS

Glue is applied to selected portions of box blanks moving in spaced relation to each other by a continuously swinging glue arm, with provision for stopping and restarting the arm if the next blank is not in proper position. Patent 2,776,224 by Omer E. Cote, assigned to United States Automatic Box Machinery Co.

METAL STAMPING MACHINE

Machine marks articles as they proceed along a course of travel. Two pneumatic cylinders controlled by a photoelectric circuit swing a marking arm and move it parallel with the article. Patent 2,776,617 by James M. Hendrickson, assigned to the Pannier Corp.

AUTOMATIC DIP SOLDERING AND DIP TINNING MACHINE

Feed device supplies objects to clamps on continuously rotating platform. Clamps move vertically to dip objects in flux, solder and bath liquids. Clamps open and close automatically. Patent 2,776,640 by Haaren A. Miklofsky and Harold S. Horiuchi, assigned to United States of America.

SERVO POSITIONING MECHANISM

To locate a driven device in varying positions of adjustment, a number of shafts are independently connected to the driving mechanism, and each of these shafts carries a brush which engages commutator bars mounted around the shaft. Patent 2,777,109 by Arlon G. Sangster.

DEVICE FOR AUTOMATIC BALANCING OF ROTATING MACHINE PARTS

Balancing masses carried in arcuate chambers of a rotating body are automatically positioned to balance the body by the flow of liquid into the chambers from a film of the liquid which supports the shaft in a sleeve. The sleeve has several chambers which assure rapid shifting of the masses and adequate lubrication. Patent 2,778,243 by Georges Darrieus, assigned to Aktiengesellschaft Brown, Boveri & Cie, Baden, Switzerland.

Automate with AIR
(Vacuum—Suction—Pressure)

Countless automatic operations are handled faster, simpler, more economically with

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- Feeding
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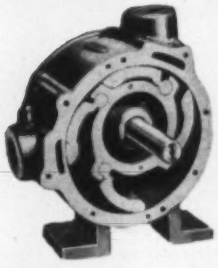
- Many more

LEIMAN
Rotary Air and
VACUUM PUMPS



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Investigate the many uses and advantages of air for automatic operations—how other industries are using air—how you might use air. Your best source for such information is Leiman—with 60 years' background in the manufacture and application of air pumps. And the best pump for your job is a Leiman Air Pump for higher capacity—larger volume—trouble-free operation—longer life. Write for literature—outline your needs.

Many types and sizes:
Vacuums to 29.9″ Hg.
Pressures to 20″ psig.
Displacement to 162 c.f.m.

LEIMAN BROS., Inc.
121 Christie St., Newark 5, N. J.

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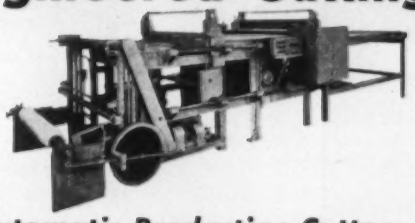
HOBBS AUTOMATES Engineered Cutting



Automatic Production Cutter
Electronically Controlled For Speed and Accuracy

Combine your feeding, guiding, slitting, measuring, cutting and conveying — also stacking if desired — in one automatic operation. This machine takes materials from rolls or from a preceding process by synchronization. Also semi-automatic models.

HOBBS Knows Cutting
Let Hobbs Automate A Cutting Plan To Your Requirements.

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WINDERS • HAND & POWER SHEARS • DIE PRESSES SLITTERS • CORNER CUTTERS

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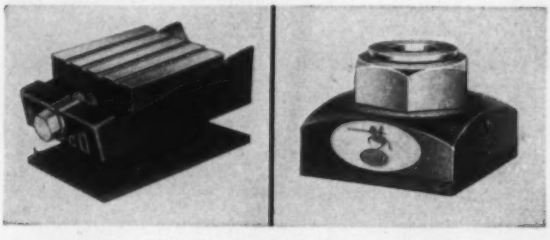
any new machine deserves an **EMPCO** *leveling jack*



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Installing new machines? *Set* them level, and *keep* them level with EMPCO Leveling Jacks. EMPCO jacks provide a solid, smoothly adjustable foundation for machine tools, large surface plates, automation lines, tool room and production equipment of all types. The result is better machine performance . . . higher precision . . . reduced downtime and maintenance. Where vibration problems exist, use VI-SORB Mounting Pads with your EMPCO Jacks. They control internal and transmitted vibration, reduce noise and prevent creepage (eliminate the need for anchor bolts in many cases). EMPCO Jacks are available in six styles, 25 models. VI-SORB Mounting Pads are cut to fit. Write us about your machine installation problems.

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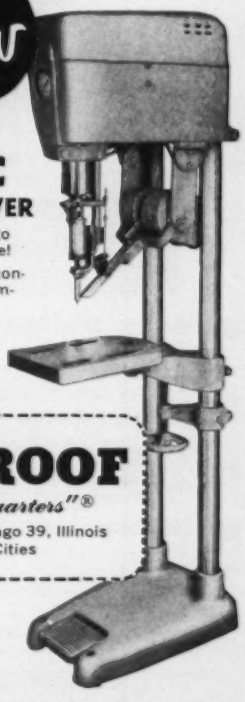
AUTOMATIC
POWER SCREW DRIVER

- New Model "400" can drive up to 60 hopper-fed screws per minute!
- Ideal for automation as well as conventional mass-production assembly lines!

Write for this today!
Model "400" Catalog Flyer



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SHAKEPROOF / FASTEX Divisions of Illinois Tool Works

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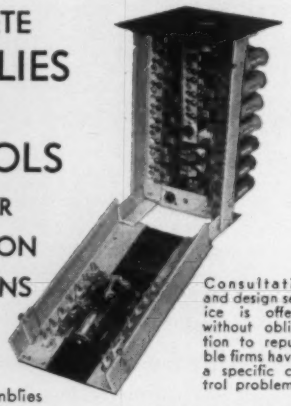
ASSEMBLIES
OF
CONTROLS
FOR YOUR
PRODUCTION
OPERATIONS



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Compact and simplified for easy accessability.

"Package Controls to Count, Select, Grade, Guide, Reject and Perform All Manufacturing Functions"

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ONE COMPLETE AUTOMATION ORGANIZATION

- ENGINEERING SURVEYS AND STUDIES
- ASSEMBLING STANDARD AUTOMATION COMPONENTS AND MACHINE TOOLS INTO AN INTEGRATED PROCESS
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ELECTROTABLE

All-electric packaged unit • geneva action • adjustable built-in timer • accurate locking pin • central column for mounting accessories such as Electropunch (illustrated) • low tooling cost.

Write for folder showing complete line of Black & Webster solenoid-operated production tools.

BLACK & WEBSTER, INC.

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SOLENOID-OPERATED PRODUCTION TOOLS

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push-pull
CONTROLS

Compression & Tension Type

Aircraft cable is strung with spherical steel shells in a rigid or flexible housing sealed with "O" rings. 3" standard bend radius. ¾" minimum bend radius.

Three Types:

1. *Light Duty*—Compression Ult. Load 1250 lbs.; Ult. tension 960 lbs.
2. *Heavy Duty*—Compression Ult. Load 1650 lbs.; Ult. tension 960 lbs.
3. *Extra Heavy Duty*—Compression Ult. Load 3050 lbs.; Ult. tension 3900 lbs.

Positive remote controls for actuating mechanical, hydraulic or other devices. Eliminate bell cranks, pulleys and dual cables. Patented U. S. A. All world rights reserved. Send for ENGINEERING MANUAL giving detailed prints and complete specifications covering materials, finishes, capacities. Please address Dept. A-57

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1705 SO. MOUNTAIN AVE., MONROVIA, CALIFORNIA

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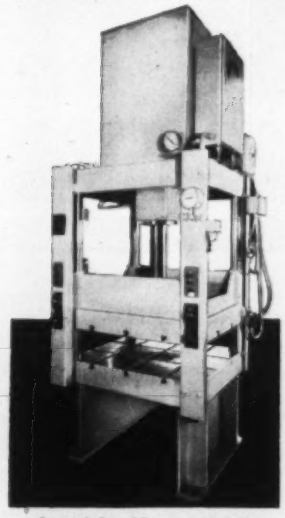

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To fill your commitments on time . . . economically and accurately . . . Our exclusive Weldment construction assures ruggedness and durability...easy modification to other requirements. Eliminate pattern cost.

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AQ* ------CUTS SHORT RUN STAMPING COSTS--------

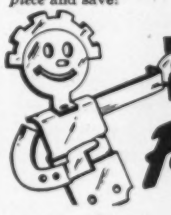
PROBLEM:

Relay Support Bracket with
9 holes—two different sizes
Tolerance—hole dia. + .002/– .001; location ± .003
Blank size (developed)—1¼" x 3"
Material—.062 C. R. Strip Steel

RELAY BRACKET HOLE PUNCHING ANALYSIS

CONVENTIONAL	Single Hole "Short Run" jig punching Tools and first 1,000 pieces Subsequent re-runs 1,000 pieces	 $125.00 $102.00
CONVENTIONAL	"Permanent Gang Die" Punching Tools and first 1,000 pieces Subsequent re-runs 1,000 pieces	 $266.00 $11.00
FEDERAL	"Multiple Hole Process" Punching Tools and first 1,000 pieces Subsequent re-runs 1,000 pieces	 $70.00 $41.00

In analyzing the problem it was found that only through Federal's multiple hole-punching process could stamping costs be cut and still hold to rigid tolerances. Let Federal quote on your next *problem piece* and save!



*Analyzed Quotation

Federal TOOL & MFG. CO.

Quality Stampings in Small Quantities

3629 Alabama Ave., Minneapolis, Minnesota

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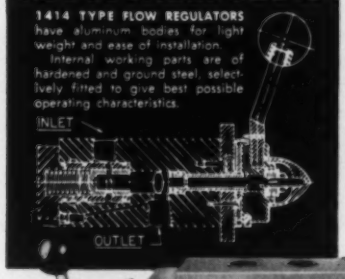
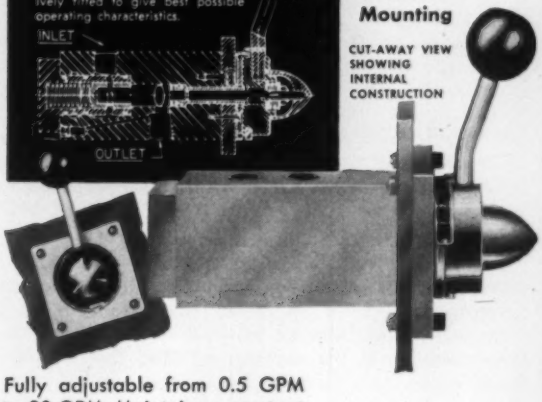
ADJUSTABLE FLOW REGULATOR

1414 TYPE FLOW REGULATORS have aluminum bodies for light weight and ease of installation. Internal working parts are of hardened and ground steel, selectively fitted to give best possible operating characteristics.



CUT-AWAY VIEW SHOWING INTERNAL CONSTRUCTION

Designed for Panel Mounting



Fully adjustable from 0.5 GPM to 20 GPM. Maintains a constant rate of flow regardless of work resistance or pressure fluctuations.

Also SOLENOID VALVES, MICRONIC LINE FILTERS and CHECK VALVES.

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725 CUSTER AVENUE EVANSTON, ILLINOIS

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Ametron® ELECTRONIC CRANE SCALES

Weighs heavy loads suspended from crane hook. Printer, located in crane cab or other convenient location, records weight on tape or cards. New compact printer only 22" x 18" x 10½".

Entire assembly designed for prompt and easy installation. Now available at new low cost. Capacities 5, 10, 15 tons.

Write for Free Ametron Brochure 2

STREETER-AMET COMPANY

GRAYSLAKE, ILLINOIS

THE STANDARD OF ACCURACY SINCE 1888

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speed small parts output ...with automatic feed

- speeds elevating transfer of piston pins, tappet bodies and similar short-length parts.
- adjustable from minimum 20" to maximum discharge height of 130" at any desired rate of feed.
- compact, self-contained. Has ¼ HP, variable speed drive. Special cam take-off for timing auxiliary units. Actual floor space: 24" x 36".

FASTER OUTPUT is only part of the story. This versatile Feedall machine provides fully automatic feed, with low operating cost and minimum upkeep. It occupies only small floor space and can be adapted to a wide range of production requirements. Added features include simple installation, rugged construction, proved results.

OTHER AUTOMATIC Feedall machines are available, including hopper units with elevating, blade, rotary and vibratory feeds. All may be combined with elevating transfer or through-feed conveyors.

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MANUFACTURING METHODS AND PROCESSES

By Arthur C. Ansley, president Arthur Ansley Mfg. Co.; 561 pages, 6 by 9 inches, illustrated, clothbound, published by Chilton Co., Philadelphia; available from AUTOMATION; *$12.50 postpaid.*

A profusely illustrated review of production methods, tools and materials is presented in this book. Text briefly discusses processes used with metals, woods, plastics and ceramics. Over 450 photographs show workpieces and equipment found in American industry. Without attempting to give detailed technical information on particular processes, this volume does offer a very broad survey of manufacturing practices of interest to students as well as to people in industry.

Industrial Publications

A DISCUSSION OF AUTOMATIC LOGGING

Paperbound, 23 pages, 9½ by 11 inches, illustrated; available from Cook Electric Co., 2700 Southport Ave., Chicago 14, Ill.; $1.00.

Published as Vol. 3 No. 1 of the Cook Technical Review, this paper discusses automatic data logging systems and the components involved. Transducers, techniques for scale factor adjustment and linearizing, scanning, analog-to-digital conversion, programing, recording and alarm are covered.

IDEAS—THE BEGINNING OF ALL THINGS

Paperbound, 16 pages, 8¼ by 10¾ inches; available from the Jaqua Co., 101 Garden St., Grand Rapids 2, Mich.; 50 cents.

Booklet presents a brief discussion of basic principles of creative thinking. Steps in creative thinking are outlined as saturation, incubation, illumination and verification. It is suggested that group meetings should inspire thinking in three dimensions—before the meeting, at the meeting and after the meeting.

A PRIMER TO THE AUTOMATIC OFFICE

Paperbound, 93 pages, 6¼ by 9¼ inches, illustrated; available from Automation Management Inc., Westboro, Mass.; $7.50.

Booklet describes some of the background for the present state of office automation and considerations and equipment involved. A bibliography of related material is included. This volume is not intended as a detailed design guide, but merely as an aid to orientation of the reader to this field.

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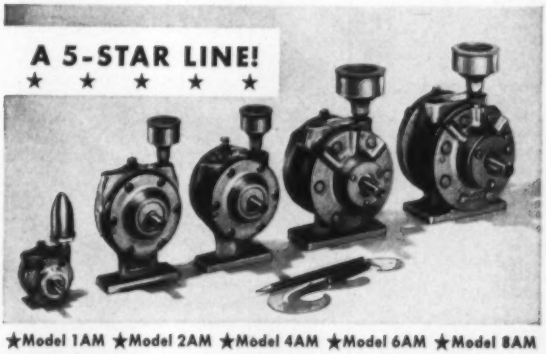

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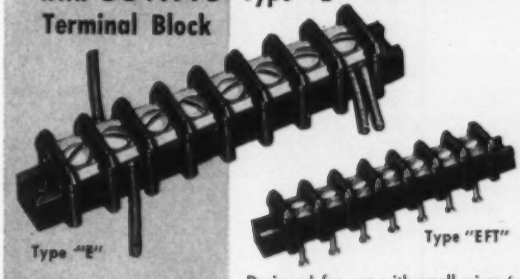

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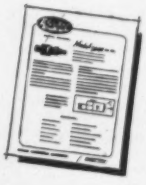

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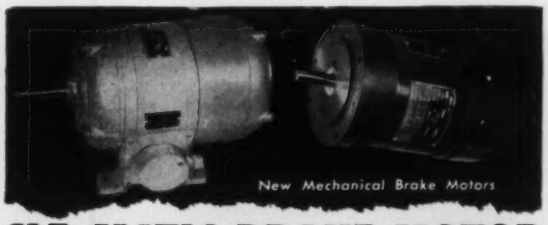

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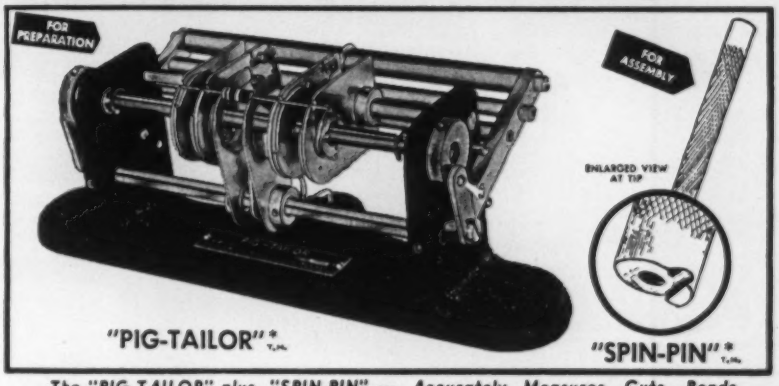

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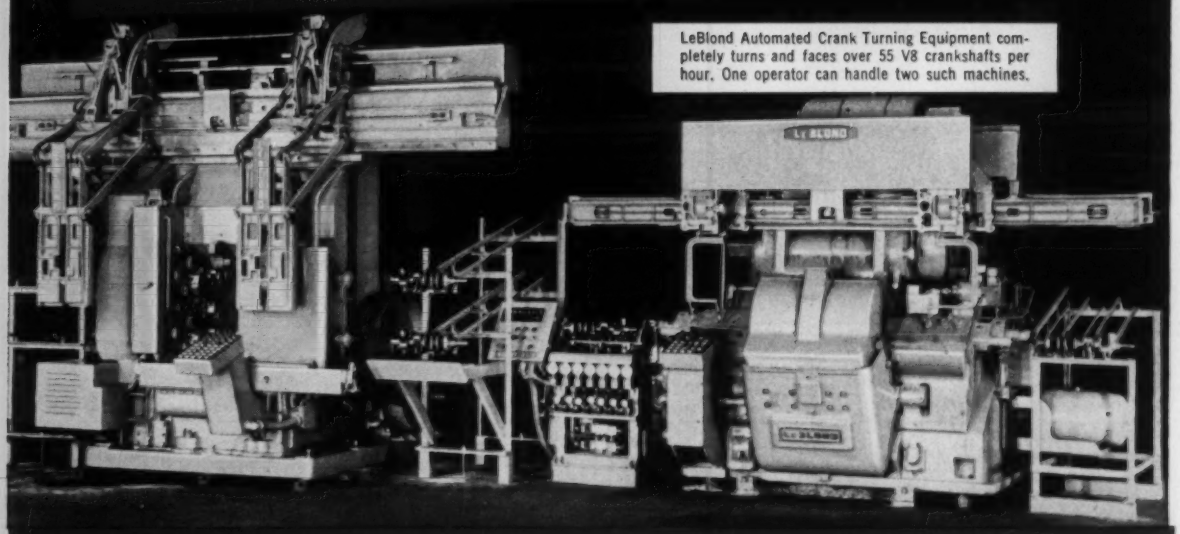

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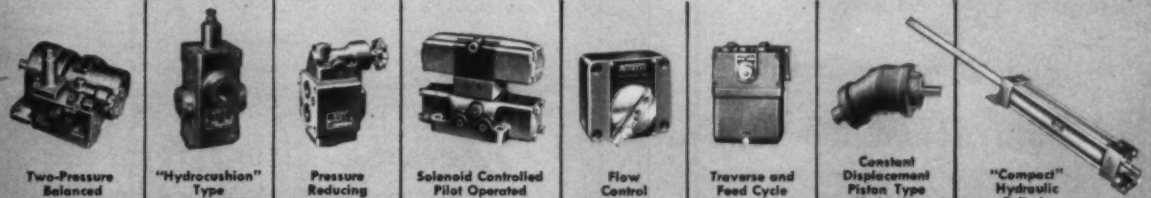

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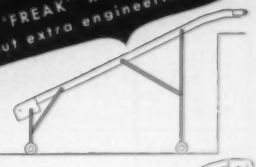

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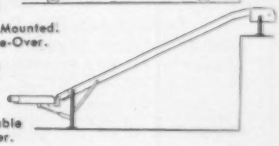
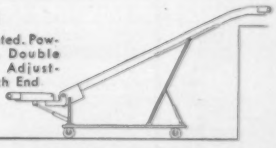
Four Wheel Mounted. Double Nose-Over.



TYPE 22
Double Nose-Over and Adjustable Power Feeder.



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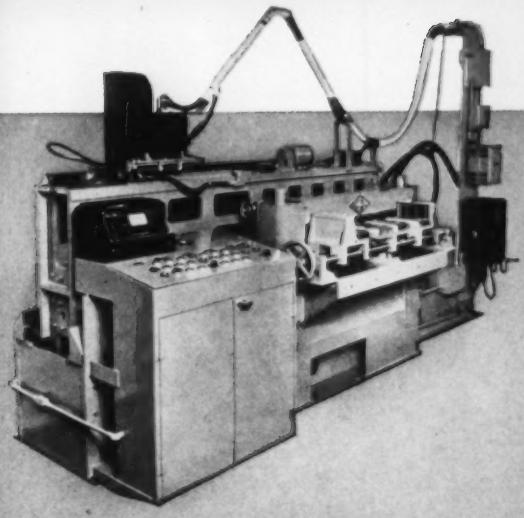
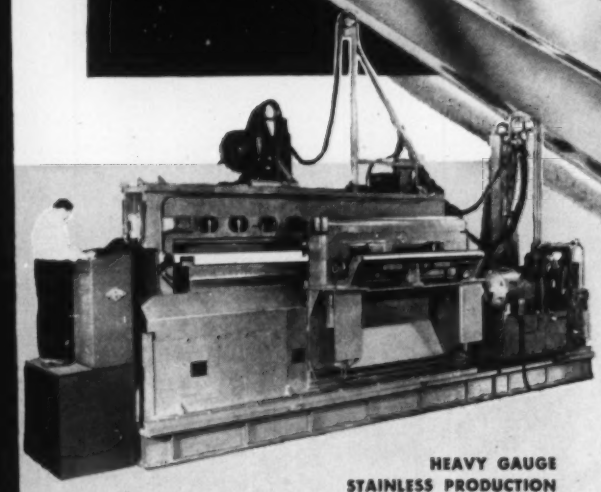


CONTINUOUS SILICON SHEET PRODUCTION

Shearwelder for coil build up line for 42" wide Silicon Steel from .015" to .030" thick.



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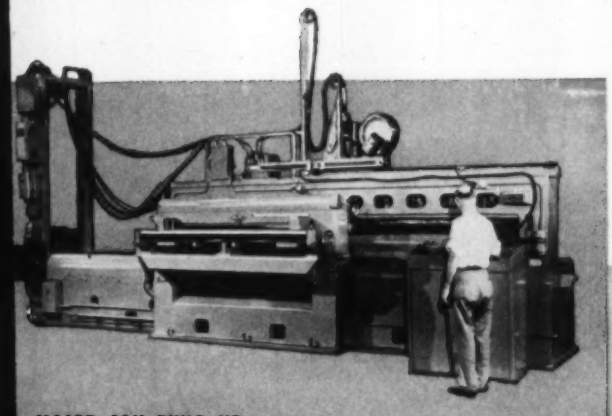
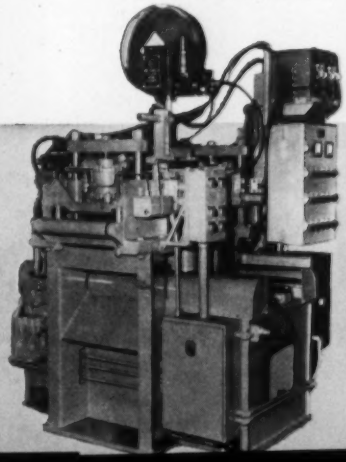


MAJOR COIL BUILD UP

Shearwelder for Carbon Steel coil build up line for .015" to .060" thick x 72" maximum width.



CONTINUOUS TUBE MILL PRODUCTION

Shearwelder used with strip looping device for splicing coil to coil to permit continuous production of tube mill.

Circle 552 on Inquiry Card

10065

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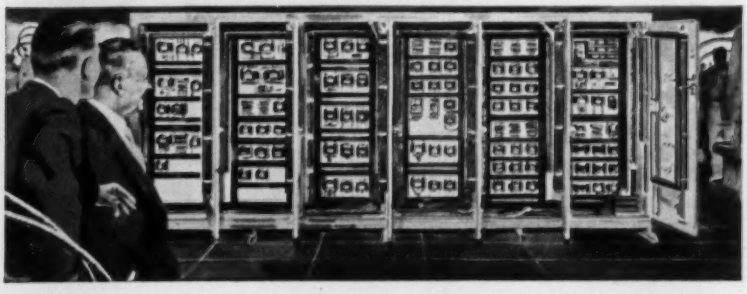
Control cabinet doors of Barnes machine opened to show array of Cutler-Hammer Three-Star Motor Control components used.



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